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The Manual of American Water-Works

1888

Engineering News

Knowles' Improved Compound Condensing Pumping Engines,

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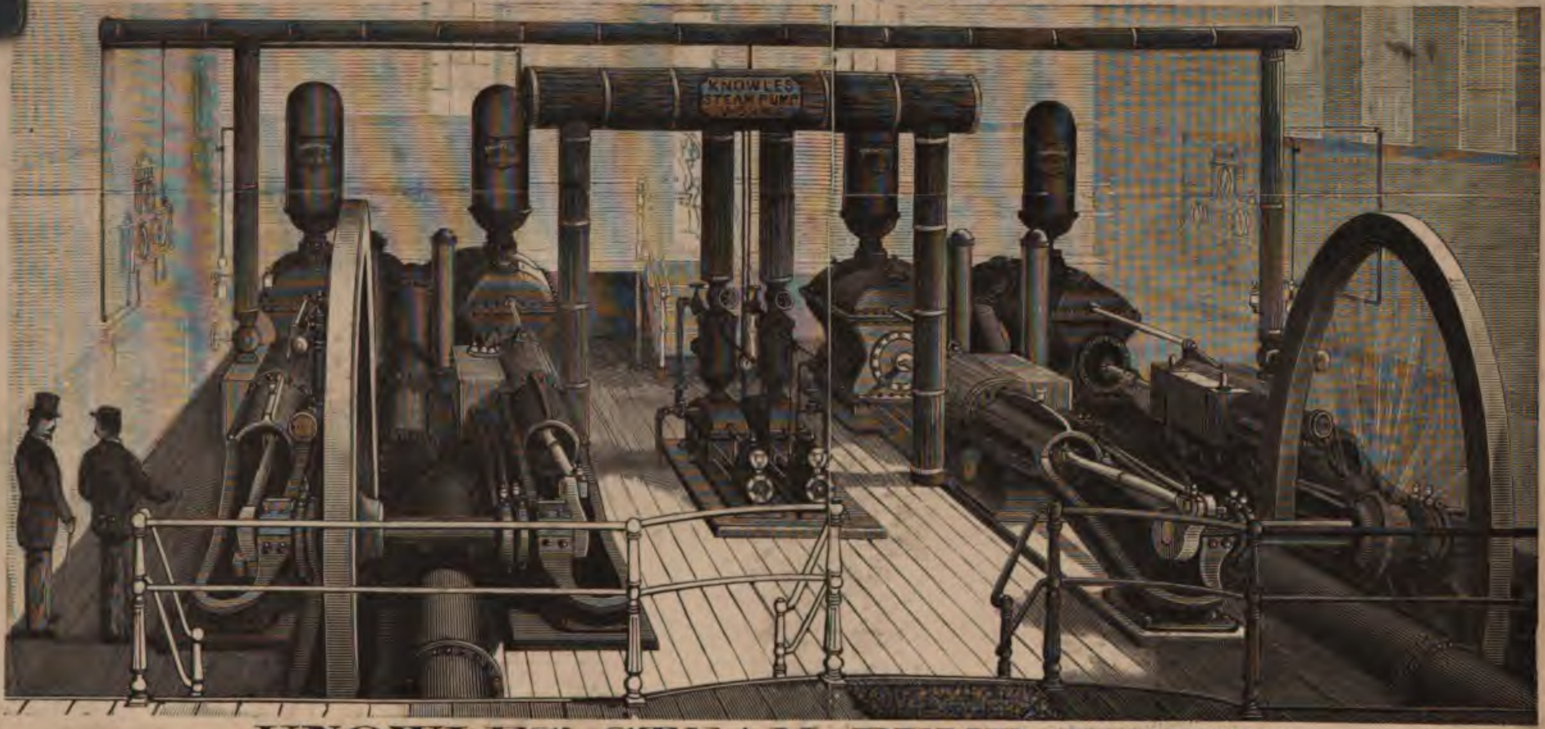

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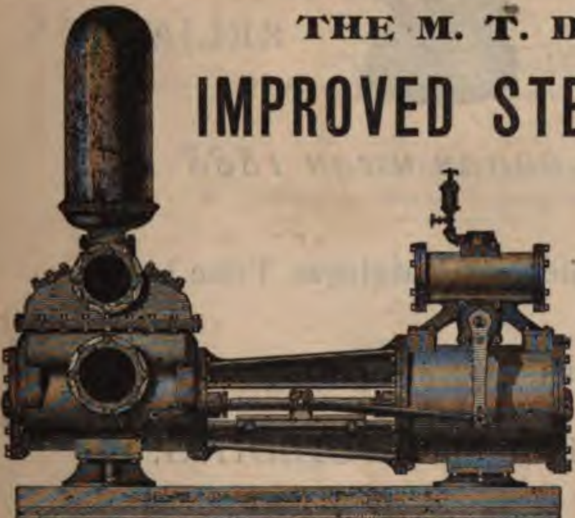

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WITH SUMMARIES
For Each State and Group of States;

AND DIRECTORY
Of Water-Works Officials, Engineers and Contractors.

M. N. BAKER, Ph. B., EDITOR.

1888.

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1889.

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A PARTIAL LIST

OF THE

STAND-PIPES

OF THE

UNITED STATES.

THEIR HEIGHTS, DIAMETERS, THICKNESS, AND OTHER DETAILS OF CONSTRUCTION.

CLASSIFIED FIRST IN ORDER OF DIAMETERS, AND SECONDLY, IN ORDER OF HEIGHTS.

[Rearranged, corrected, and somewhat extended from the table accompanying paper by B. F. Stephens, C.E., published in Engineering News, Oct. 6, 1888. This table, however, includes barely half the stand-pipes in the United States.]

STAND-PIPES OF THE UNITED STATES, *Continued.*

Height of Stand-Pipe.	Lansing, Mich.	Yonkers, N. Y.	Maryville, Mo.	Lexington, Mo.	Waterford, N. Y.	Princeton, N. J.	Wellington, Kan.	Cleburne, Tex.	Beloit, Kan.	Adams, N. Y.	Houlton, Me.	Perth Ambo	
250													
248													
244													
240													
236						On Trestle 60 ft. high, 32x18.	On Stone Tower 85 ft. high.						
232													
228													
224													
220													
216													
212													
208													
204													
200													
196													
192													
188													
184													
180													
176													
172													
168													
164													
160													
156													
152	152												
148				150									
144				3-16									
140													
136													
132			130										
128	5-32												
124													
120	3-16												
116													
112	¼												
108													
104	9-32												
100													
96	5-16												
92													
88													
84	⅜												
80													
76	11/32												
72												71	
68	13/32												
64	15/32												
60												¼	3
56	½												
52											50		
48	17/32										5-16		
44													
40	9-16									40			4
36	19/32												
32		31								.134			
28	⅝								30				
24							24	25	¼				
20	11/16					18							
16	23/32	3-16							5-16	.148			5
12													
8													6
4	¾	½		¾	?	⅜		3-8	⅜	3-16	½	⅝	7
Diameter	18	18½	18½	18½	20	20	20	20	20	20	20	20	
Bottom	1 S			¾	⅜	⅜		⅜	⅜	⅜			
Material	S				I	I	W	I	I	I	I		
Date	'86				'86	'83		'84		'85	'85		
Brackets			B	B	O								
Guyed	O		O	O	O						O	Y	
Bolted	Y		Y	Y	Y						O	O	
Cost to Clean.	10				5	10		3			5		
Cost	12						10	40					
Pressure Day.	65				80		45						
" Night													
Tower						T	T		T				

CONTENTS.

Stand Pipes of the United States.

Abbreviations (*See Preface.* [illegible]
Introduction. [illegible]
Water-works completed in process of construction, projected, or reported projects since become indefinite in

United States.

PAGE
Alabama. 276
Arizona. 532
Arkansas 474
California 511
Colorado 491
Connecticut 76
Dakota 454
Delaware 165
District of Columbia 243
Florida 272
Georgia 266
Idaho 538
Illinois 365
Indiana 328
Iowa 405
Kansas 427
Kentucky 291
Louisiana 283
Maine 1
Maryland 236
Massachusetts 24
Michigan 341
Minnesota 420
Mississippi 282
Missouri 463
Montana 461
Nebraska 445
Nevada 534
New Hampshire 12
New Jersey 148
New Mexico 502
New York 89
North Carolina 260
Ohio 300
Oregon 507
Pennsylvania 168
Rhode Island 70
South Carolina 264
Tennessee 285
Texas 478
Utah 536
Vermont 19
Virginia 247
Washington Territory 504
West Virginia 257
Wisconsin 391
Wyoming Territory 459

Dominion of Canada.

British Columbia 564
Manitoba 564
New Brunswick 539
Newfoundland 543
Nova Scotia 541
Ontario 550
Prince Edward's Island 543
Quebec 544
Group 1—New England States 1
2—Middle " 89
3—South Atlantic " 247
4—South Central " (Gulf & Mississippi Valley) 277
5—Middle States 300
6—North Western States 405
7—South Western " 463
8—Pacific " 504
9—Canada Maritime Provinces 539
10—Canada Interior Provinces 544

Supplement.

Reports of New Works, received too late for classification 567
Corrections and additions to Classified Reports 579
Suggestions as to a Uniform System of Reports 584
Directory of Water-Works Officials, Engineers and Contractors 586

INDEX TO ADVERTISEMENTS
AND
BUSINESS DIRECTORY.

The names and addresses of ADVERTISERS in the MANUAL are shown in prominent type; the names and addresses of SUBSCRIBERS who have paid in advance, *and who desire it*, are given in smaller type and under appropriate headings, one heading for each book paid for. This Directory will soon be a most complete list of Manufacturers and Dealers in Water Works Machinery and Supplies; also of Engineers, Contractors, Brokers, and others interested in the subject of Water-Works Construction, and its value cannot fail to be appreciated. There is *only one* MANUAL OF AMERICAN WATER-WORKS, and the easiest way to be known in the Water-Works interest is to be represented in its pages either as an ADVERTISER or a SUBSCRIBER.

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Rand Drill Co., N. Y. City. (Page xxiv.)

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Boston Belting Co., 256 Devonshire St., Boston, Mass. (See page xxviii.)

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BOILERS (Steam).

R. F. Hawkins Iron Works, Springfield, Mass. (See page xlvii.)

E. Hodge & Co., East Boston, Mass. (See page xlvii.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Porter, Jackson & Co., South Chicago, Ills.

Sharon Boiler Works, Sharon, Pa. (See page xlii.)

Tippett & Wood, Phillipsburg, N. J. (See page viii.)

***Whittier Machine* Co.,** South Boston, *Mass. (See page xv.)*

BOILERS (Steam.)—Continued.

National Water Tube Boiler Co., New Brunswick, N. J.

BOILER TUBES.

National Tube Works Co., McKeesport, Pa. (See page xiv.)

Pancoast & Rogers, 28 Platt St. N. Y. (See page xviii.)

BRASS GOODS.

See Copper and Brass Goods.

BRIDGES AND ROOFS (Iron.)

R. F. Hawkins Iron Works, Springfield, Mass. (See page xlvii.)

R. D. Wood & Co., 400 Chestnut St., Philadelphia. (See page xii.)

CASTINGS. (Globe Special).

Builders Iron Foundry, Providence, R.I. (See page liii.)

CASTINGS, (Machine).

Addyston Pipe and Steel Co., Addyston, O. and Newport, Ky. (See page xxxviii)

Chattanooga Foundry and Pipe Works, Chattanooga, Tenn. (See page xxxviii.)

R. F. Hawkins Iron Works, Springfield, Mass. (See page xlvii.)

Pancoast & Rogers, 28 Platt St. (See page xviii.)

Union Hydraulic Works, Philadelphia, Pa. (See page xix.)

R. D. Wood & Co., 400 Chestnut St. Philadelphia, Pa. (See page xii.)

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Hays Manufacturing Co. Erie, Pa. (See page xxiii.)

COCKS (Stop and Corporation.)—Continued.

Portsmouth Machine Co., Portsmouth, O. (See page xlii.)

The E. Stebbins Manufacturing Co., Brightwood P.O., Mass. (See page xxii.)

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

W. H. Ward & Co. 140 Oliver St., Boston, Mass. (See page xxx.)

CONTRACTORS (Water and Gas Works.)

Thos. V. Hall & Co. Chattanooga, Tenn. (See page xxxv.)

Jas. H. Harlow & Co., 411 Wood St., Pittsburg, Pa. (See page xxii.)

A. L. Holmes, Grand Haven, Mich. (See page xxxv.)

Moffett, Hodgkins & Clarke, Watertown, N. Y. (See page xliii.)

Scovel & Irwin Construction Co., Nashville, Tenn. (See page xlix.)

R. D. Wood & Co., 400 Chestnut St Philadelphia, Pa. (See page xii.)

COPPER AND BRASS GOODS.

Bourbon Copper & Brass Works, 198 to 204 E. Front St., Cincinnati, O. (See page xxi.)

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Hays Manufacturing Co., Erie, Pa. (See page xxiii.)

Oil Well Supply Co., Limited., 82 Fulton St., N. Y. (See page xlix.)

Portsmouth Machine Co., Portsmouth, O. (See page xlii.)

The E. Stebbins Manufacturing Co., Brightwood, P. O. (See page xxii.)

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Addyston Pipe and Steel Co., Addyston, O., and Newport, Ky. (See page xxxviii.)

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Henry F. Jenks, Pawtucket, R. I. (See page xxxiii.)

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Bassett Bros 298 Main St., Buffalo, N. Y. (See page xlv.)

Burlingame, O., Menominee, Mich.

Chase, John C. Wilmington, N. Y. (See page xx.)

Chapin, L. E., Toledo, O.

Christensen, August C., 24 State St., N. Y.

Cole, Jno. A. 69 Ashland Block, Chicago, Ill. (See page xlv.)

Cook, J. E., Toledo, O. (See page lii.)

Croes, J. James R., 13 William St., N. Y. (See page xliv.)

Davis, Chester B. The "Rookery," Chicago, Ills. (See page xliv.)

Dye & Datesman, 706 Chestnut St., Philadelphia, Pa. (See page xlv.)

Ellsworth, Emory A. Holyoke, Mass. (See page xliv.)

Fanning, J. T., Union Depot, St. Paul, Minn. (See page xliv.)

Forbes & Co. A. W. 101 Milk St, Boston, Mass. (See page xliv.)

Fuller, Frank L. 12 Pearl St., Boston, Mass. (See page xlv.)

Goodrich, Wm. W. Oakland, Cal. (See page xlvi.)

Grant, E. W., Kansas City, Mo.

Hammatt, E. A. W. 5 Pemberton Square, Boston, Mass. (See page xlv.)

Hanover, M. D., 88 Tribune Building, N. Y. City.) (See page l.)

Harman, Jacob A. Watseka, Ills. (See page xlv.)

Harlow, James H. Pittsburgh, Pa. (See page xxii.)

Hartford, R. Frank, City Hall, Memphis, Tenn, (See page xxxvi.)

Hering, Rudolph, 31 Chambers St., N. Y. (See page xlv.)

Hill & Stout, 29 Broadway, N. Y. (See page xx.)

Geo. Hornung, 30 E. 4th St., Cincinnati, O. (See page xx.)

Jenkins, W. Dunbar. 118 W. 6th St., Kansas City, Mo, (See page xlv.)

King, George A., 7 Summer St., Taunton, Mass.

Knight & Bontecou, Kansas City, Mo. (See page xlv.)

Lucius, Albert, 71 Broadway, N. Y.

Searles, Wm. H. Cleveland, O. (See page xlv.)

Simons, Joseph, 35 Broadway, N. Y.

Smalley, E. Delevan, Canastota, N. Y.

Stanton, Robert B. 28 Barclay Block, Denver, Col. (See page xlv.)

Stevens, Walter C., Melrose, Mass.

Vermuele & Bien, 78 Broadway, N. Y.

ENGINEERS, CIVIL.—Continued.

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Webster, Albert L. 107 Drexel Building, cor. Wall & Broad Sts., N. Y. (See page xlv.)

White, Wm. Henry, 32 Pine St., N. Y. (See page xlv.)

Wynn, Geo. W. Cedar Rapids, Ia. (See page xlvi.)

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Holmes, A. L. Grand Haven, Mich. (See page xxxv.)

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Moffett, Hodgkins & Clarke, Watertown, N. Y. (See page xliii.)

Pond Engineering Co.. St Louis, Mo. (See page liii.)

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A. L. Holmes, Grand Haven, Mich. (See page xxxv.)

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Jones Manufacturing Co., 243 Franklin St., Boston, Mass. (See page xxxiii.)

Jewel Pure Water Co., Chicago, Ill. (See page xxxi.)

Morison, Allen & Co., 145 Broadway, N. Y. (See page xxxi.)

National Water Purifying Co. 145 *Broadway, N. Y.* See page xxxiii.)

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Calumet Fire Clay Co. Calumet, O. (See page xxvi.)

Great Western Fire Clay Co. Toronto, Ohio. (See page xxvii.)

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Eddy Valve Co., Waterford, N. Y. (See page xiii.)

Calvin Brass & Iron Works, Detroit, Mich (See page xvi.)

Hays Manufacturing Co. Erie, Pa. (See page xxiii.)

Holyoke Hydrant & Iron Works, Holyoke, Mass. (See page xi.)

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Hersey Meter Co. So. Boston, Mass. (See page vii.)

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Geo. J. Roberts & Co. Dayton, O. (See page xxxvi.)

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Tuerk Hydraulic Power Co., 39 Dearborn St., Chicago, Ill. (See page xxxvi.)

PACKING (Steam).

Boston Belting Co., Boston, Mass. (See page xxviii.)

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Gould Packing Co., 36 Cambridge St., E. Cambridge, Mass. (See page liii.)

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PIPE. (Cast Iron.)—Continued.

Chattanooga Fdy. & Pipe Works, Chattanooga, Tenn. (See page xxxviii.)

Donaldson Iron Co., Emaus, Lehigh Co., Pa. (See page xxxix.)

Drummond, M. J., Equitable Building, 120 Broadway, N. Y. (See page xxxix.)

Glamorgan Iron Works, Lynchburg, Va. (See page xxxviii.)

Gloucester Iron Works, 6 N. 7th St., Philadelphia, Pa. (See page xl.)

Jackson & Woodin Mfg. Co., Berwick, Pa. (See page xxxix.)

Charles Millar & Son, Utica, N. Y. (Outside last cover.)

Mellert Foundry and Machine Co., Reading, Pa. (See page xlii.)

National Foundry & Pipe Works, Scottdale Pa. (See page xlii.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Reading Foundry Co., Reading, Pa. (See page xlii.)

Shickle, Harrison & Howard Iron Co., St. Louis, Mo. (See page xxxix.)

South Pittsburg Pipe Works, South Pittsburg, Ala. (See page xli.)

Union Hydraulic Works, Philadelphia, Pa. (See page xix.)

Warren Foundry & Machine Co., 160 Broadway, N. Y. (See page xl.)

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa. (See page xii.)

PIPE. (Cement Lined.)

Pennsylvania Pipe Manufacturing Co., Philadelphia, Pa.

W. H. Ward & Co., 140 Oliver St., Boston, Mass. (See page xxx.)

PIPE. (Converse Lock Joint.)

National Tube Works Co., McKeesport, Pa. (See page xiv.)

PIPE JOINTER.

Thos. Watkins, Johnstown, Pa. (See page xxx.)

PIPE. (Lead.)

Boston Lead Manufacturing Co., Boston, Mass. (See page xxix.)

Charles Millar & Son. (Outside last cover.)

PIPE. Natural Gas.

National Tube Works Co., McKeesport, Pa. (See page xiv.)

PIPE. (Sewer, Vitrified.)

Blackmer & Post, St. Louis, Mo. (See page xxv.)

Calumet Fire Clay Co., Calumet, O. (See page xxvi.)

Charles Millar & Son, Utica, N. Y. (Outside last cover.)

Great Western Fire Clay Co., Toronto, O. (See page xxvii.)

PIPE. (Sewer, Vitrified.)—Continued.

Warner, H. A., New Haven, Conn. (See page xxvii.)

PIPE. (Spiral, Riveted.)

Abendroth & Root Mfg. Co., 28 Cliff St., N. Y. (See front pages.)

PIPE. Spiral Weld.)

Spiral Weld Tube Co., 5 Beekman St., N. Y. (See page xlii.)

PIPE. (Tin Lined.)

Boston Lead Manufacturing Co., Boston, Mass. (See page xxix.)

PIPE. (Wrought Iron.)

Abendroth & Root Mfg. Co., 28 Cliff St., N. Y. (See front pages.)

National Tube Works Co., McKeesport, Pa. (See page xiv.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Spiral Weld Tube Co., 5 Beekman St., N. Y. (See page xlii.)

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

Wells Rustless Iron Co., 21 Cliff St., N. Y.

PLATE IRON WORK.

Tippett & Wood, Phillipsburg, N. J. (See page viii.)

PUMPS. (Copper and Iron.)

Boston Lead Manufacturing Co., Boston, Mass. (See page xxix.)

PUMPS. (Diaphragm and Hand Power.)

Boston and Lockport Block Co., 162 Commercial St., Boston, Mass. (See page xxix.)

PUMPING MACHINERY. (Steam.)

Barr Pumping Engine Co., Germantown Junction, Philadelphia, Pa. (See page liv.)

Geo. F. Blake Manufacturing Co., 95 Liberty St., N. Y. (See front pages.)

Davidson Steam Pump Co., 77 Liberty St., N. Y. (See front pages.)

Deane Steam Pump Co., Holyoke, Mass. (See page xlviii.)

Holly Manufacturing Co., Lockport, N. Y. (See page lv.)

Knowles Steam Pump Works. 111 Federal St., Boston, Mass. (Inside front cover.)

Pond Engineering Co., 7th and Market Sts., St. Louis, Mo. (See page liii.)

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa. (See page xii.)

Henry R. Worthington, New York. (Inside and opposite last cover.)

RADIATOR. (Steam and Hot Water.)

A. A. Griffing Iron Co., Jersey City, N. J. *(See page xxxvii.)*

RATCHET PIPE CUTTING AND THREADING TOOLS.

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

ROCK DRILLS.

Clayton Air Compressor Works, 43 Dey St., N. Y.

Ingersoll-Sergeant Rock Drill Co., 10 Park Place, N. Y.

Rand Drill Co., 23 Park Place, N. Y. (See page xxiv.)

ROUGH STOPS.

The E. Stebbins Mfg. Co., Brightwood P. O., Springfield, Mass. (See page xxii.)

RUBBER GOODS.

Boston Belting Co., Boston, Mass. (See page xxviii.)

Chicago Rubber Works, 230 Randolph St., Chicago, Ill.

N. Y. Belting & Packing Co., 15 Park Place, N. Y. (See front pages.)

SEWER EXCAVATING MACHINERY.

H. A. Carson, 68 Devonshire St., Boston, Mass. (See page xlix.)

SLUICE GATES.

Coffin Valve Co., 295 & 297 South St., Boston, Mass. (See page xx.)

STAND PIPES.

R. F. Hawkins Iron Works, Springfield Mass. (See page xlvii.)

E. Hodge & Co., S. Boston, Mass. (See page xlvii.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Porter, Jackson & Co., South Chicago, Ill.

Porter Manufacturing Co., Syracuse, N. Y.

Sharon Boiler Works, Sharon, Pa. (See page xlii.)

Tippett & Wood, Phillipsburg, N. J. (See page viii.)

STEAM FEED WATER PURIFIER.

Stilwell & Bierce Mfg. Co., Dayton, O. (See page l.)

STEAM, GAS AND WATER WORKS SUPPLIES.

Appleton, A., 45 Cortlandt St., N. Y.

Clow & Son, James B., 222 Lake St., Chicago, Ill.

Gilbert & Barker Manufacturing Co., 10 & 12 Dey St., N. Y.

Hays Manufacturing Co., Erie, Pa. (See page xxiii.)

Charles Millar & Son, Utica, N. Y. (Outside last cover.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Ripley & Bronson, St. Louis, Mo.

U. S. Supply Co. Ltd., 51 John St., N. Y.

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

STOCK CERTIFICATES.

Homer Lee Bank Note Company, Tribune Building, N. Y. City. (Back Cover.)

STREET WASHERS.

Hays Manufacturing Co., Erie, Pa. (See page xxiii.)

SUBMERGED WORK.

A. L. Holmes, Grand Haven, Mich. (See page xxxv.)

TANKS.

Corcoran, Andrew J., 76 John St., N. Y.

R. F. Hawkins Iron Works, Springfield, Mass. (See page xlvii.)

E. Hodge & Co., S. Boston, Mass. (See page xlxii.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Whittier Machine Co., South Boston, Mass. (See page xv.)

TAPES. (Measuring.)

Geo. M. Eddy & Co., 345 Classon Ave., Brooklyn, N. Y. (See page xlvi.)

TAPPING MACHINES.

Charles Carr, 7 Exchange Pl., Boston, Mass. (See page x.)

Wm. M. Crane & Co., 766 Broadway, N. Y. (See page ix.)

Hubbell, D. T., Bethel, Conn. (See page xxix.)

Lennox Machine Co., Marshalltown, Ia. (See page xxviii.)

Letzkus, A., Pittsburgh, Pa. (See page xxviii.)

Walworth Manufacturing Co., 16 Oliver St., Boston, Mass. (See page xxx.)

TURBINE WHEELS.

R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa. (See page xii.)

VALVES. (See Hydrants and Valves.)

VALVES. (Locked "Pop" Safety.)

Ashton Valve Co., Boston, Mass. (See page i.)

VALVES. Rubber.

Boston Belting Co., Boston, Mass. (See page xxviii.)

VALVES. Water, Relief.

Ashton Valve Co., Boston, Mass. (See page i.)

WATER SUPPLIES. (Gang Well.)

Andrews & Bro., Wm. D., 233 Broadway, N. Y.

Oil Well Supply Co., Limited, 82 Fulton St., New York. (See page xlix.)

WATER WORKS SECURITIES.

Hanover, M. D., 88 Tribune Building, New York City. (See page l.)

Maine Savings Bank, Portland, Me

Municipal Investment Company, First National Bank Building, Chicago, Ill.

H. M, Payson & Co., Portland, Me.

Swan & Barrett, Portland, Me.

C. H. Venner & Co., Boston, Mass. (See page xliv.)

WATER PRESSURE REGULATORS.

Foster, J. M., 145 Broadway, N. Y. (See page liv.)

Kieley, Timothy, 11 W. 13th St., N. Y.

Mason Regulator Co., Boston, Mass. (See page xxi.)

WELLS.

Hydraulic Tube Well Construction Co., 145 Broadway, N. Y. (See page l.)

WELL CASINGS.

National Tube Works Co., McKeesport, Pa. (See page xiv.)

Pancoast & Rogers, 28 Platt St., N. Y. (See page xviii.)

Tippett & Wood, Phillipsburg, N. J. (See page viii.)

WELL TUBING.

Cook Well Co., 705 Market St., St. Louis, Mo.

National Tube Works Co., McKeesport, Pa. (See page xiv.)

WINDMILLS.

Corcoran, Andrew J., 76 John St., N. Y.

Chapman Valve Mfg. Co.,

MANUFACTURERS OF

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For Water, Gas, Steam, Oil, Acid, Ammonia, Etc.

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PREFACE.

After more than a year of work in collecting, compiling and summarizing the accompanying information the publishers submit this first annual issue of the AMERICAN WATER-WORKS MANUAL to the water-works officials, engineers and contractors of the country, and to those capitalists who invest in water-works securities, as well as to all who take an intelligent interest in the sanitary and financial questions involved in the construction and maintenance of water-works systems.

In preparing the MANUAL for publication two obstacles were met; the first the incomplete record of the number and locations of the water-works of the country, and the meager existing information concerning them, and the second the extreme difficulty experienced in obtaining complete reports from some works, and any kind of a report from others. To our first inquiries only about half of the works responded, and to the second less than half of the delinquents; after a third and to some a fourth or fifth inquiry had been sent the number of unreported works was reduced to 100. As many as eight separate inquiries were sent out to obtain information regarding some of these. If, then, some reports are incomplete, and errors appear in others, it is not owing to lack of effort on our part.

We trust and believe that hereafter the difficulty in obtaining reports will be much less. It goes without saying that the MANUAL, as it is, is by far the most complete collection of water-works information ever published. Nearly all the data is directly from persons connected with the respective works, or from the Annual Reports made by them. Of the remainder most has been given by the designing or constructing engineer of the system, or the contractor, and some by the prominent residents of the town in which the works are located.

Such errors or omissions as may be found will be corrected in the succeeding (1889) edition, and we request all noticing errors or omissions to inform us of them.

Our thanks are due and given to the large number of officials who have spared no pains to respond to all inquiries, and also to the engineers and contractors who have reported on the systems with which they have been connected. We especially thank those companies controlling several systems, for their kindness in sending in reports of all their works, thus saving us much trouble, and insuring greater accuracy.

Annual Reports of water-works systems are valuable helps in compiling the MANUAL, and we request these from all officials publishing the same, together with the schedule of water rates charged to consumers.

To show the growth of the water-works of the country since 1850, we propose to give in the next edition of the MANUAL the exact status of each system at the close of the decades 1860, 1870, 1880, and also at the close of 1885. We therefore request the officials of systems built prior to 1886 to give us for each of these dates, or as many as the history of their system includes, the cost of their works to each date, with the revenue for that year, and the miles of pipe, number of taps, meters and hydrants, then in use. If figures for the above years cannot be given those for the nearest possible year will be acceptable.

Our next following annual issue will be illustrated with maps, and will contain many other new and valuable features, as well as corrections of all discoverable errors in this first issue, and continuation of the statistics for another year.

The Appendix to this issue contains a good many corrections, and also records of *about* 40 new water-works received too late to incorporate in the main body of the work. To ensure obtaining the fullest information about any work, reference should also be made to the Appendix.

For the sake of convenience and brevity the abbreviations on the following page were used in the MANUAL.

M. N. BAKER, *Editor.*

ABBREVIATIONS.

Ann. op. exp.	Annual operating expenses.
Ann. Rev.	Annual revenue.
Av.	Average.
Av. dy.	Average daily.
Cap.	Capacity.
c. i.	Cast-iron.
Com. or Comm.	Committee.
Comr. or Commr.	Commissioner.
Co.	Company.
Const. Engr.	Constructing Engineer.
Contr.	Contractor.
Co.	County.
Dy. cap.	Daily capacity.
Des. Engr.	Designing Engineer.
diam.	diameter.
Engr	Engineer.
est.	Estimated.
ft.	feet.
galls.	Gallons.
galv. i.	Galvanized i.
Gen. Mgr.	General Manager.
H. P.	Horse power.
Imp.	Imperial.
in.	Inches.
Incorp.	Incorporated.
Int.	Interest.
kal. i.	Kalemein i.
lbs.	Pounds.
Mgr.	Manager.
p.	Page.
pp	Pages.
Pop.	Population.
Prest.	President.
Pumpg Eng'r.	Pumping Engineer.
Secy.	Secretary.
sq. ft.	square feet.
Sub-contr.	Sub-contractor.
Supt.	Superintendent.
Treas.	Treasurer.
V. Prest.	Vice President.
Vol.	Volume.
w. i.	Wrought iron.

MANUAL
—OF—
AMERICAN WATER-WORKS.

1888.

INTRODUCTION.

The accompanying volume is the first Manual of American Water-Works, properly so called, which has ever been published, not even the number of water-works and the most essential data in regard to them having been before accurately known. In the year 1878 the publisher of Engineering News made the first attempt in that direction, having arranged with Mr. J. James R. Croes, C. E., of this city, the well known hydraulic engineer, to compile for this journal the "History and Statistics of American Water-Works," and the result of his very careful and successful work was embodied in a little volume under that title published in 1883, and again in revised and enlarged forms in 1885 and 1887, as also in a series of sketches of the various works which have been published in Engineering News from time to time since 1881, and have constituted the basis of the present volume.

The first (1883) edition, of this record, gave in tabular form more or less details as to 793 water-works; the second (1885) edition, gave similar information as to 989 water-works, and the third (1887) edition, gave similar information as to 1,391 water-works; but in each issue there were a large number of works unavoidably omitted, and the information which could be secured from those water-works which did report was often so scanty that it was found impossible to attempt summaries or tabulations by States or Sections, exhibiting in aggregate the status of water-works.

Aided by the growing interest which these prior publications created, the publishers have at last succeeded in eliminating nearly all these sources of error and imperfection, and are now able to present not only practically complete statistics of the water-works interest of the United States, but likewise to embody a vast amount of information as to the history and construction of the individual water-works which has either never been in print before or has only existed in inaccessible form.

This Manual will be issued annually hereafter, and it is hoped and expected to make it each year more complete and valuable, for, while the publishers feel that they have reason to be well satisfied with the present volume as the first issue of the series, it is necessarily not as complete as it will gradually become. In the next issue, for 1889, will be included a series of colored maps showing the location and statistics of water works, and the financial, historical and technical data given in this issue will be considerably extended. It will enable this to be done more effectively if all readers will examine the account of water-works with which they may be, or may have been, connected, and supply any omissions of matter which ought to appear.

The records not here given which are particularly desired are the status of all the earlier water-works at the ends of the decennial periods 1860, 1870, 1880, and in 1885, in respect to cost, miles of mains and number of taps, hydrants and meters, in order that we may exhibit fully the status of water works at each date, which it is impossible to do with exactness in this issue. The following records as they stand bear striking evidence to the vast recent growth of water-works, as will be seen on examination. We proceed to summarize all the information which has been gathered by States and Sections, and for this purpose the United States has been divided into the same groups as are used in Poor's *American Railroad Manual*, with the single exception that Kansas is transferred from the Southwestern to the Northwestern group as follows:

GROUP 1. (*A*)—*New England States.* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

GROUP 2. (*B*)—*Middle States.* New York, New Jersey, Delaware, Pennsylvania, Maryland and District of Columbia.

GROUP 3. (*C*)—*South Atlantic States.* Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.

GROUP 4. (*D*)—*South Central States.* (Gulf and Mississippi Valley.) Alabama, Mississippi, Louisiana, Tennessee, Kentucky.

GROUP 5. (*E*)—*North Central States.* Ohio, Indiana, Michigan, Illinois, Wisconsin.

GROUP 6. (*F*)—*Northwestern States.* Iowa, Minnesota, Kansas, Nebraska, Dakota, Wyoming, Montana.

GROUP 7. (*G*)—*Southwestern States.* Missouri, Arkansas, Texas, Colorado, New Mexico.

GROUP 8. (*H*)—*Pacific States.* Washington, Oregon, California, Arizona, Nevada, Utah, Idaho.

To this, which includes the whole United States, there is added,

GROUP 9. (*I*)—*Canada Maritime Provinces.* New Brunswick, Nova Scotia, Prince Edwards Island, Newfoundland. (Newfoundland is not practically a part of the Dominion of Canada, but geographically it belongs with them.)

GROUP 10. (*J*)—*Canada Interior and Western Provinces.* Quebec, Ontario, Manitoba and British Columbia.

At the conclusion of the summaries by sections is given a summary of the whole United States and Canada. The tables referring to the same subject in every group and in the summary are given the same number; distinguishing between them only by appending the letters B, C,D, etc., to the number. Thus Table 16, 16-B, 16-C, etc., refers to pumping machinery throughout; and so for all other tables.

THE WATER-WORKS OF THE NEW ENGLAND STATES.

The water-works of New England (and of the United States as well, so far as we know) began where so much else that is good has begun, in Boston, Mass., in 1652, where a reservoir 12 ft. square near the present Dock Square was supplied by pipes from neighboring springs, and used for fire and domestic purposes. In 1796 an "Aqueduct Corporation," with a capital of $30,000 supplied the town with water from Jamaica Pond through pitch pine logs. Two years later Portsmouth, N. H., and Worcester, Mass., started works The first has been continuously operated since, but the last named works were reconstructed in 1845, and the date of the completion of the first works of real importance constructed in each State is shown by the first date in Table 3, viz., 1798 in New Hampshire, 1801 in Massachusetts, 1820 in Vermont, 1832 in Connecticut, 1851 in Maine and not till 1876 in Rhode Island.

How vastly more rapid the recent growth of water-works has been is strikingly shown even by the figures for the New England States summarized in Table 1, 2. There were,

	No. Water-Works
Before 1850, a total of	13
In the decade ending 1860 there were built	16
" " " " 1870 " "	32
" " " " 1880 " "	76
" " 7½ years " 1888 " has been built	150
A total of	287

Thus considerably more than half the water-works of New England have been built within the last 7½ years, and 78 of them, or 27 per cent. have been built within the last 2½ years. Of course, the newer works supply a much smaller average population than the older ones, which were for large cities only, but the population statistics of Table 5 and others show that a very large fraction of population like wise has only been supplied within the last few years. When we remember that New England is markedly more advanced than any

TABLE I.

NEW ENGLAND WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION

[Date of completion taken when construction extended over more than one year.

YEAR.	Water Works Built.			YEAR.	Water-Works Built.		
	Main.	Subsidiary.	Total.		Main.	Subs.	Total.
Before 1800	1	0	1				
1800-10	2	0	2	1871	2	1	3
1811-20	2	0	2	1872	7	0	7
1821-30	1	0	1	1873	14	0	14
1831-40	3	0	3	1874	7	0	7
1841-50	3	0	3	1875	8	0	8
1851	1	0	1	1876	10	1	11
1852	1	0	1	1877	3	0	3
1853	0	0	0	1878	6	1	7
1854	2	1	3	1879	8	1	9
1855	4	0	4	1880	6	1	7
1856	1	0	1	1881	8	1	9
1857	2	0	2	1882	9	3	12
1858	0	0	0	1883	9	1	10
1859	1	0	1	1884	21	1	22
1860	2	1	3	1885	16	3	19
1861	1	0	1	1886	16	2	18
1862	3	0	3	1887	24	6	30
1863	0	0	0	1888	20	2	22
1864	1	0	1	Unknown.	8	0	8
1865	1	0	1	Total.	254	32	286
1866	1	0	1				
1867	2	1	3				
1868	4	1	5				
1869	9	1	10				
1870	4	3	7				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems.

other section as respects water-works, and has within it a large proportion of the water-works dating before 1870 it will be seen at once how strong evidence these tables afford of the rapid growth of a great interest. The similar statistics for the Southern and Western States seem as if everything almost in the way of water-works had been done since 1880.

TABLE II.

NEW ENGLAND WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Subsidiary Water-Works are indicated by numerals in parentheses.]

DATE.	Water-Works Built in						Total.	Grand Total.
	Maine.	N. H.	Ver't.	Mass.	R. I.	Conn.		
Before 1800	..	1	..	0	..	..	1	1
1800-10	..	1	..	1	..	..	2	2
1811-20	..	1	1	0	..	..	2	2
1821-30	..	1	..	0	..	..	1	1
1831-40	..	1	..	1	..	1	3	3
1841 50	..	..	2	1	..	..	3	3
1851-55	1	1	1	(1) 4	..	1	(1) 8	9
1856-60	..	..	1	1	..	(1) 4	(1) 6	7
1861 65	..	..	..	3	..	3	6	6
1866 70	(3) 2	1	2	(3) 9	..	6	(6) 20	23
1871-75	2	4	2	(1) 25	..	5	(1) 38	39
1876 80	(1) 4	..	6	(2) 14	(1) 3	6	(4) 33	38
1881 85	7	(1) 4	3	(6) 39	(2) 2	8	(9) 63	72
1886-88	(6) 16	14	4	(1) 21	(2) 6	(1) 7	(10) 68	78
Total	(10) 32	(1) 29	22	(14) 119	(5) 11	(2) 41	(32) 254	286

According to the record of our "Statistical Tables" of 1886, which, while comparatively incomplete, is interesting for comparison, there were:

	In New England	Rest of U. S.	Total
Works built,			
1801 to 1870 inclusive	57	145	202
1871 to 1886 inclusive	161	816	977
Unknown	40	172	212
Total	258	1133	1391
Increase p. c. since 1870.	182¼	462	383

We have now, only two years later, 287 water-works in New England, an increase of 29, or 14½ per year, against 10 per year in the very active period 1871-86.

The capital invested in New England water-works has now reached the enormous aggregate of $84,902,725, or $21.20 per head of total population and $35.30 per head potentially supplied. The magnitude of this interest will be better appreciated by comparing it with the railway interest. Taking the figures of the last "Railroad Manual" we have, in even figures:

	Capital invested in		
	Railways	Water-Works	Ratio.
Maine	$40,328,000	$6,417,000	6.27 to 1
New Hampshire	24,474,000	2,915,000	8.39 "
Vermont	34,182,000	1,391,000	24.60 "
Massachusetts	196,618,000	56,041,000	3.51 "
Rhode Island	5,791,000	9,431,000	1 to 1.65
Connecticut	50,274,000	8,797,000	5.71 to 1
Total New England	$351,667,000	84,903,000	4.12 to

TABLE 3.

MAIN DETAILS OF THE WATER-WORKS OF NEW ENGLAND BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the condition of the works at that date, but merely as the *present condition* of works then existing.]

DATE.	Present Pop'n Suppl'd.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Independent.	Subsidiary.	T'tal	Cost.	Rev.		Taps.	Hdr'ts	M'ters.
					MAINE.					
1851-60	15,002	1	0	1	$500,000	$40,000	80·00	1,200	112	0
1861-70	50,466	2	3	5	1,750,000	242,000	121·00	7,425	336	164
1871-80	53,825	6	1	7	1,321,940	137,484	95·90	6,323	411	75
1881-85	31,577	7	0	7	435,000	41,367	48.50	2,151	243	12
1886-88	57,647	16	6	22	2,410,000	227,052	160·55	3,540	642	222
Total.	208,717	32	10	42	6,416,910	687,903	505·95	20,639	1,744	473
					NEW HAMPSHIRE.					
1798-50	22,820	5	0	5	$85,500	$18,200	30·50	735	23	25
1851-60	13,397	1	0	1	250,000	27,500	35.00	2,500	75	25
1861-70	6,784	1	0	1	211,096	12,917	30,00	1,187	138	0
1871-80	52,896	4	0	4	1,400,876	84,498	118·63	5,515	559	776
1881-85	10,586	4	1	5	323,000	17,970	33·05	1,100	184	13
1886-88	28,356	14	0	14	614,500	17,775	80·03	727	333	19
Total.	134,839	29	1	30	2 914,972	178,860	327·21	11,764	1,312	858
					VERMONT.					
1820-50	6 582	4	0	4	$136,000	$14,600	22·43	1,066	104	10
1851-60	8.815	2	0	2	136,000	17,870	20·00	1,130	60	0
1861-70	13,147	2	0	2	399,351	33,560	35·58	2,540	195	374
1871-80	20,601	8	0	8	412,000	24,532	58·50	2,473	253	2
1881-85	6,980	3	0	3	162,000	4,100	12·50	325	22	0
1886-88	11,405	4	0	4	146,000	7,300	27.00	400	83	3
Total.	67,530	22	0	22	1,391 351	101,962	176·01	7,934	717	389
					MASSACHUSETTS.					
					$	$				
1801-50	390,339	3	0	3	20,052.483	1,329,141	536·50	59,535	5.292	3,115
1851-60	134,831	5	1	6	4.772.358	390,676	285·30	21 077	1,751	7,095
1861-70	218,542	12	3	15	5.819.196	657.788	469·03	41,089	2,675	759
1871-80	437.728	39	3	42	18,400,061	1,230,273	1043.70	62,599	7,320	10,600
1881-85	220,186	39	6	45	5,186,736	341 383	535.40	24,907	3,456	2,144
1886-88	69,415	21	1	22	1.810,548	95,019	202·85	4,389	1 344	251
Total.	1,471,041	119	14	133	56,041,382	4 045,282	3072·78	213,596	21,838	23,964
					RHODE ISLAND.					
1876-80	144.636	3	1	4	$8.271,330	$517.449	350·00	20,423	2,276	10,535
1881-85	39,850	2	2	4	619,871	41,403	55·35	2,135	614	679
1886-88	13,778	6	2	8	539.500	17.230	38·00	625	198	127
Total.	198,264	11	5	16	9,430,701	576,082	443.35	23,183	3,088	11,341
					CONNECTICUT.					
1832-50	990	1	0	1	$5,000	$506	1·80	——	——	
1851-60	99,681	5	1	6	3.112,338	298,421	214·00	14.665	601	381
1861-70	143,828	9	0	9	3.698,934	394,490	297·50	15,247	1,913	358
1871-80	31,525	11	0	11	932,807	66,054	111·60	4,792	478	64
1881-85	20,502	8	0	8	490,800	30,510	73·50	2,228	291	12
1886-88	32,642	7	1	8	557,500	32,560	67·00	1,356	318	73
Total.	329,168	41	2	43	8,797,379	822,535	765·40	38,288	3,601	888

TABLE 4.

NEW ENGLAND WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3.

State.	Present Pop'n on Water-Works.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subsid-uary.	Total.	Cost.	Revenue		Taps.	Hyd'ts	Meters
Maine	208,517	32	10	42	$6,416,940	$687,903	505·95	20,639	1,744	473
N Hamp..	134,839	29	1	30	2,914,972	178,860	327·21	11,764	1,312	858
Vermont .	67,530	29	0	23	1,391,351	101,962	176.01	7,934	717	389
Mass......	1,471,041	119	14	133	56,041,382	4,045,282	3,072.78	213,596	21,838	23,964
R. Island .	198,264	11	5	16	9,430,701	576,082	443·35	23,183	3,088	11,341
Conn......	323,168	41	2	43	8,797,379	822,535	765.40	38,288	3,601	888
Total N.E.	2,409,359	255	32	287	84,992,725	6,412,624	5,290·70	315,404	32,300	37,913

TABLE 5.

NEW ENGLAND WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL NEW ENGLAND WATER-WORKS, AS GIVEN IN TABLE III.

Date.	Present Pop'n on Water-Works.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subsid-uary.	Total.	Cost,	Revenue		Taps.	Hyd'ts	Meters
1798-1850	420,731	13	0	13	20,278,983	$1,362,443	591·23	60,336	5,419	3 150
1851-60	271,726	14	2	16	8,770,696	774,467	634·30	40,572	2,599	7,501
1861-70	432,767	26	6	32	11,878,577	1,340,755	953·11	67,488	5,257	1,655
1871-80	741,211	71	5	76	30,739,014	2,060,290	1,778·33	104,125	11,297	22,052
1881-85	329,681	63	9	72	7,217,407	476,733	758·30	32,846	4,810	2,860
1886-88	213,243	68	10	78	6,108,048	397,936	575·43	11,037	2,918	695
Total	2,409,359	255	32	287	84,992,725	6,412,624	5,290·70	315,404	32,300	37,913

N. B.—This table does not represent the status of the works at the several dates (except as to number) but the statistics for the *current year* of works first opened at the several dates.

It will be seen that Rhode Island has nearly twice as much capital invested in water-works as it has in railways, thus enjoying the proud distinction of leading all the States in this respect; but the New England States, as a whole, have nearly one-quarter as much invested.

In revenue the water-works compare somewhat less favorably, their revenue being only $6,412,624 against $66,324,051 of gross and $19,266,191 of net railway revenue. This is but natural, since so very large a proportion of the water-works are public enterprises run purely for the public good to afford water at minimum cost, and without a thought of profit. Nevertheless, their gross revenue is 7.54 per cent. on cost, and the net nearly 7 per cent., as compared with 4.68 per cent. on railway stocks and 4.80 per cent. on railway bonds; so that on the surface they are more profitable than railways. The difference is, however, that there is very little "water" in the water-works capital account, while there is a good deal in the railway capital account, even in New England.

In miles of mains the water-works approach much more nearly to the railways. The figures are, in even miles:

	Miles of mains	Miles of R. R.
Maine	506	1,240
New Hampshire	327	888
Vermont	176	865
Massachusetts	3,073	2,531
Rhode Island	443	150
Connecticut	765	1,010
Total New England...	5,291	6,684

Few would imagine, unless told, that the miles of water mains approached so closely to the miles of railway even in New England, largely exceeding the miles of railway in Massachusetts and Rhode Island.

We regret that it is impossible for us, this year, to give the actual financial and operating status of water-works as they stood at the end of each decennial period of the past. The nearest we can come to it in this issue is to show the *present* status of the works first opened in each decade. It must be fully borne in mind that Tables 3 and 5 do no more than this, and hence greatly underrate the growth of the later periods as compared with the earlier ones. Even as it is, the contrast is sufficiently striking. Out of the total investment of $85,000,000 in New England water-works, $13,325,000 has been in *new* works since 1880, and $44,064,000, or more than half, in *new* works since 1870, but of the remaining $41,936,000 now invested in works antedating 1870 fully one-half of it, we judge, has been invested since that date, so that in reality some three-fourths of the total water-works interest even of New England has been created since 1870. In our next annual volume we shall endeavor to give these facts more exactly.

The population statistics given in Table 6 are among the most interesting given. There was an obvious unfairness in comparing States and sections in respect to water-works on the basis of total population, for the reason that it is only in towns that water-works supply is very feasible, and a different proportion of the total population is congregated in towns and cities in the different States. As the U. S. census of 1880 gives a table showing the town population in towns of over 4000 inhabitants we have used that as a basis rather than the total population in all the States. Moreover, we have used

TABLE 6.

NEW ENGLAND STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.

States.	Total Population.			Town Population 1880.	Per c. of total.	Pop'n on Water-Works.			Av. pop'n on each Water Wks	
	1870	1880	Inc. p. c.			Total 1880	P. C. of total pop'n.	P. C. of town pop'n.	Main works only.	Main & sub w'ks together
Maine	626,915	648,936	3.5	135,900	20.9	208,517	32.2	153.4	6,516	4,965
N. Hamp.	318,300	346,991	9.0	91,400	26.3	134,839	38.9	147.5	4,650	4,494
Vermont	330,551	332,286	0.5	37,800	11.4	67,530	20.3	178.2	2,936	2,936
Mass.	1,457,351	1,783,085	22.3	1,175,139	66.0	1,471,042	82.5	125.2	12,360	11,060
R. Island	217,353	276,531	27.2	213,600	77.2	198,264	71.9	92.8	18,024	12,391
Conn.	537,454	622,700	15.8	335 500	53.9	329,168	52.9	98.1	8,028	7,655
Total N. E.	3,487,924	4,010,529	15.0	1,989,339	49.6	2,409,359	59.8	120.6	9,441	8,391

Massachusetts, apart from Boston 8,400

Compare also Table 13.

only the 1880 census population of the towns in compiling statistics, although we give the estimated present population likewise in the account of each separate work. It is unfortunate that our Government is not sufficiently enlightened to cause a census to be taken every five years in a rapidly growing country like our own, and for lack of it, comparisons of the various groups of States on the basis of the 1880 population only, leads to somewhat deceptive results. To minimize this evil so far as possible we give both the 1870 and 1880 population, with the percentage of increase, and also the percentage of town population in 1880, which shows some striking contrasts. Speaking broadly, every New England State has the whole of its town population supplied by water-works and from 25 to 78 per cent. more of the population in smaller towns likewise so supplied.

The average population per water-works will be seen to be smallest in Vermont, 2,936, in part from the fact that Vermont has no large towns, but also from the fact that Vermont has a far larger proportion of small town works than any other State in New England or the Union. No doubt this is in good part due to a greater abundance and propinquity of good sources of supply, a very unusual proportion of the works being by gravity, as will be seen in Table 9. In large degree the whole of New England enjoys this advantage, as compared with most of the Southern and Western States, and this fact is to be borne in mind in comparisons. Connecticut is at some disadvantage in respect to sources of supply, as will be seen by Tables 8 and 9, and this probably explains the fact that it compares somewhat unfavorably in number of works, especially in the number of works for small towns, for which a small investment only is admissible.

Table 7 gives the facts in regard to the sizes of towns supplied, and

TABLE 7.

NEW ENGLAND STATES.—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1.000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over.	Total No.
Maine	9	12	9	7	4	1	42
New Hamp	7	11	4	3	4	1	30
Vermont	4	11	4	3	1		23
Mass	10	34	36	25	15	13	133
Rhode Island	3	4	1	3	4	1	16
Connec't	7	8	11	7	7	3	43
Total N. E.	40	80	65	48	35	19	287

The smallest work is Drewsville, N. H. (1804), supplying 90 people.

STATE.	Per cent. of Water-Works for Towns of Under 1,000	1,000 to 3,000	3,000 to 5,000	Over 5,000	Total.
Maine	21.4	28.6	21.4	28.6	100.0
New Hampshire.	23.3	36.7	13.3	26.7	100.0
Vermont	17.4	47.8	17.4	17.4	100.0
Massachusetts.	7.5	25.6	27.1	39.8	100.0
Rhode Island	18.7	25.0	6.3	50.0	100.0
Connecticut	16.3	18.6	25.6	37.5	100.0
Total New Eng	13.9	27.8	22.6	35.7	100.0

from it we may deduce the preceding percentages of towns of various sizes:

This table shows that Massachusetts is not entitled to so much credit for enterprise, in comparison with her sister States, as other figures might seem to show, since she has by far the smallest proportion of small works for small town supply.

This same fact is indicated by the following Table 8, showing the cost and revenue per tap, mile of main, etc. Massachusetts shows almost the largest investment per head, but the revenue per tap and mile of main is much less in New Hampshire and Vermont, showing that water-works have been very actively pushed in these States. Maine shows a very profitable system of water-works, as is natural from the fact that its works are nearly all private enterprises put up for profit, and of course expecting it. Thrifty Connecticut shows likewise a high rate of profit, perhaps due, in part, to the scarcity of the water supply.

TABLE 8.

NEW ENGLAND WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

	Cost per			Revenue per			Population		P. C. rev. to Cost.
	head	mile of main.	tap.	head	mile of main.	tap.	per tap.	per meter.	
Maine	$30.70	$12,700	$311	$3.29	$1,360	$33.30	10.1	440	10.70
New Hampshire	21.60	8,900	247	1.33	548	15.20	11.5	158	6.14
Vermont	20.60	7,890	175	1.51	579	12.85	8.5	173	7.34
Massachusetts..	38.10	18,250	262	2.75	1,308	18.90	6.9	61	7.21
Rhode Island ..	47.50	21,3.0	405	2.90	1,296	24.75	8.5	17	6.11
Connecticut.....	26.80	11,620	229	2.50	1,073	21.40	8.6	37	9.34
Av. N. E	35.30	16,080	269	2.66	1,213	20.30	7.6	63.4	7.54
Boston W. W'ks.	53.90	44,700	352	3.52	2,920	23.10	6.6	117	6.52
Pr'denceW.Wks.	59.40	30,800	474	3.34	1,736	26.70	8.0	14	5.63

Table 9 brings out the advantage which New England has as respects gravity supply very clearly, more than half the works being so supplied, and more than seven-eights in Connecticut and three-quarters in Vermont. Of the 125 pumping works, 50 pump to reser-

TABLE 9.

NEW ENGLAND WATER-WORKS.—KIND OF WORKS.

STATE.	Gravity.	Pumping to					Unk'n.	Total.	P. C. gravity works.
		Reservoir.	Tank.	Stand-Pipe.	Direct.	Unk'n.			
Maine.	10	9	5	3	1	1	1	30	33.3
New H'pshire.	14	6	—	3	5	1	—	29	48.3
Vermont	18	1	—	—	5	—	—	24	75.
Massach'setts.	51	28	12	20	10	—	2	123	41.5
Rhode Island.	1	3	3	4	—	—	—	11	9.1
Connecticut...	36	3	1	1	—	—	—	41	87.8
Total N. E...	130	50	21	31	21	2	3	258	50.4

As some of the works have a double system, the totals exceed by 3 that of Table IV. Some other gravity works have small auxiliary pumping systems for special service which have been disregarded.

voirs, 21 to tanks, 31 to stand-pipes and 21 only pump direct to the mains, but there are a number of others which pump direct in casn of fire, but which have not been so classified. Compared with other sections, direct pumping is not common in New England, while reservoirs are very largely used.

SOURCES OF SUPPLY.

The various sources of supply specified in Table 10 will be seen to be quite different in the different States. The chief supply of Maine comes from rivers, of New Hampshire, and Vermont from springs, and of Massachusetts from "ponds" and lakes, "pond" meaning in many cases a pretty good sized lake. The large number of 41 out of 123 works are thus supplied in Massachusetts. Rhode Island supplies 7 out of 11 works from rivers and brooks, while Connecticut's chief source of supply is "surface water", no; less than 17 being described as thus supplied, out of 41, with 13 others from "brooks and springs", which means a much larger proportion of

TABLE 10.

NEW ENGLAND WATER-WORKS.—SOURCES OF SUPPLY.

STATE.	Surface.	Spr'gs.	Brook.	River.	Lake.	Pond	Wells.	Unk'n.	Total.
Maine	1	5	2	11	4	3	1	3	30
New H'pshire.	—	8	5	4	6	2	2	2	29
Vermont	1	11	2	5	3	2	—	—	24
Massach'setts.	17	15	22	10	13	28	15	3	123
Rhode Island.	—	—	4	3	—	2	2	—	11
Connecticut	17	6	7	3	6	1	—	1	41
Total N. E.	36	45	42	36	32	38	20	9	258
Per cent.	14·0	17·4	16·3	14·0	12·4	14·7	7·7	3·5	100·0

NOTE.—"Pond" in New England often means a good sized lake, and fully two-thirds of the "ponds" would be more accurately described as lakes.

TABLE 11.

AVERAGE WORKING PRESSURES OF NEW ENGLAND WATER-WORKS.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence considerably higher than the effective pressure.]

PRESSURE lbs. per sq. in.	Maine.	N. H.	Ver't	Mass.	R. I.	Conn.	Total.
20 or under	1	—	—	—	—	—	1
21-30	—	—	—	3	—	—	3
31-40	2	2	—	11	1	2	18
41-50	1	2	1	14	2	4	24
51-60	5	3	1	18	4	4	35
61-70	1	5	3	20	—	5	34
71-80	3	2	3	20	1	8	37
81-90	3	2	2	8	1	3	19
91-100	3	1	3	7	3	6	23
101-110	1	—	2	3	—	—	6
111-120	1	1	—	—	—	1	3
121-130	1	—	2	3	—	2	8
131-140	—	—	—	1	—	—	1
141-150	—	—	—	1	—	—	1
151-160	—	—	1	—	—	—	1
161-170	—	—	—	—	—	—	—
171-180	—	—	—	1	—	—	1
Total works reporting.		18	18	110	12	35	215
Av. pressure lbs.	74	68	90	70	68	76	72⅚

surface supply, doubtless, than the same terms in the more northerly States.

It should not be understood that the "surface water" supply is necessarily inferior. Wetake it that in most cases it is a combination of spring, brook and surface supply, and that many of those which are described as supplied by springs or brooks in other States really have their main supply from the surface rainfall, collected as it always is in an impounding reservoir where it materially purifies itself. Much of the "pond" and even lake supply is also, doubtless, surface water, in many cases.

Supply from wells is as yet far from frequent in New England, there being only 20 works so supplied in all, and wells are likely to remain unusual in New England since the topography favors other modes of supply almost everywhere.

WORKING PRESSURES.

The working pressures range highest in Vermont, averaging 90 lbs. or 18½ lbs. above the average of all New England, 72½ lbs. The lowest working pressure in Vermont is 50 lbs., while the highest, 156 lbs. at Montpelier, is with one exception in Massachusetts (Cottage City).

TABLE 12.

FIRE PRESSURE OF NEW ENGLAND WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE. lbs. per sq. in.	Me.	N. H.	Vt.	Mass.	R. I.	Conn.	Total.
41-50	—	—	—	3	—	—	3
51-60	1	—	—	1	—	—	2
61-70	1	—	—	1	—	—	2
71-80	—	1	—	3	1	—	5
81 90	—	—	1	4	1	1	7
91-100	2	1	—	7	—	1	11
101-110	—	—	2	1	—	—	3
111-120	—	—	1	3	—	2	6
121-130	2	—	—	1	—	—	3
131 140	—	—	—	2	—	—	2
141-150	—	—	1	2	—	1	4
151-160	—	—	—	1	—	—	1
161-170	—	—	—	—	—	—	—
171-180	—	—	—	1	—	—	1
181 190	—	—	—	—	—	—	—
191-200	—	—	—	1	1	—	2
Unknown.	—	—	—	1	—	—	1
Total Works reporting.	6	2	5	32	3	5	53

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.	Total.
10 lbs. or under.	1	—	1	4	1	1	8
11 20	—	—	—	5	1	1	7
21-30	1	2	1	3	—	—	7
31 40	—	—	1	7	—	2	10
41-50	3	—	—	3	—	—	6
51-60	1	—	1	1	—	—	3
61-70	—	—	1	3	—	—	4
71-80	—	—	—	4	—	1	5
81-90	—	—	—	1	—	—	1
150	—	—	—	—	1	—	1
Unknown.	—	—	—	1	—	—	1
Total Works reporting.	6	2	5	32	3	5	53

the highest in New England. In all, 40 works make no report of pressure.

Nearly 90 per cent. of the New England water-works have their working pressures between 35 and 100 lbs., only 4 being lower than the lower limit, as shown more fully in Table 11.

FIRE PRESSURES.

Of the 215 works reporting pressures, 53 report higher pressure for fire purposes, as shown in Table 12. The most common fire pressure will be seen to be 85 to 110 lbs., ranging all the way from 45 to 200 lbs. The average increase above the normal will be seen in the lower part of the same table to be less than 40 lbs., although some works (mostly the smaller ones, in towns which desire to dispense altogether with fire engines) increase pressures 150 lbs. The obvious objection to any extreme change of pressure is the inconvenience and injury to the regular supply.

OWNERSHIP OF THE WORKS.

In this there are some surprising contrasts. The great State of Massachusetts shows its greatness and enterprise in nothing more conspicuously than in the public spirited way in which its towns and cities have taken hold ofthe work of supplying themselves with water at their own expense instead of waiting for private enterprise to do it for them. No less than 78 out of the 133 water-works in Massachusetts are public property, supplying 1,280.144 out of the 1,471,041 supplied, or 87 per cent. By a singular coincidence the latter total comes *within one person* of the total population of Massachusetts in towns of 4,000 inhabitants or over (1,471,041 against 1,471,042) so that we may say practically that every town in Massachusetts of over 4,000 inhabitants has been supplied with water by its own public enterprise, there being in addition 55 private works, supplying an average population of 3,470.

Of no other large State in the Union is anything like this true, but the little State of Vermont does even better, having 12 per cent. more of its population than there is in towns of 4,000 inhabitants or over

TABLE 13.

OWNERSHIP OF NEW ENGLAND WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	Me.	N. H.	Vt.	Mass.	R. I.	Conn.	Total.
City or town	4	7	10	78	5	15	119
Local Company	34	19	10	49	10	27	149
Outside Company	3	4	—	2	—	—	9
Individuals	1	—	3	2	1	1	8
Unknown	—	—	—	2	—	—	2
Total No	42	30	23	133	16	43	287
Pop'n supp'd by public works	39,792	63,165	42,451	1,280,141	158,758	156,267	1.740.574
Total pop'n on W. W's	208,517	134,839	67,530	1.471.041	198,264	829,168	2,409.359
P. C. supplied by cities	19.2	46.8	63.0	87.0	80.2	47.3	72.3
Pop'n on private works	168,725	71,674	25,079	190.900	39.506	172,901	668,785
Pop'n per private work	4,440	8.110	1.930	3,470	2,630	6.180	3,980
P. C. of total city pop'n supplied by public works	29.4	69.2	112.2	100.0	74.3	46.5	87.5

supplied with water at public expense. It has also a smaller poption per private water-works than in any other State, or 1,930 against 2,630 in Rhode Island, 6,180 in Connecticut and 3,980 in the whole New England States. The record of the average population per private water-works, given in the next last line of Table 13, is perhaps the fairest criterion of any of the extent to which a community has been supplied, since the larger works are generally all city works, whose population varies greatly, and so disturbs the value of the average population per water-works of all kinds.

At the other extreme of the New England States comes Maine, with only 4 public works out of 42, and only 29.4 per cent. of its city population supplied by such works. As will be seen from Tables 2 and 3 Maine has likewise been comparatively backward in beginning water-works, more than half of its works having been built within the last two years. On the other hand, it will be seen from the ninth column of Table 6 that Maine is exceeded only by Vermont in its proportion of population supplied by all works, having 53.4 per cent. more than its total city population thus supplied.

These water-works statistics when critically examined, however, bear interesting testimony to a fact which has been often noted, that Maine seems to suffer from the same cause which affects so much more unfavorably the growth of the Canadian maritime provinces; its comparatively isolated position, in a corner of the Union, and with only a very limited adjacent territory with which it is free to trade. In fact Maine is the State to which the provincials turn for comfort when their slow growth is in question, claiming that "they are doing as well as Maine." How true this is in other respects we will not discuss. That it is far from true as respects water-works will be very apparent from statistics to follow; but that this isolation has retarded the development of Maine we have no doubt, and the accompanying figures seem to prove.

USE OF METERS.

The use of meters is very common in the New England States compared with most of the others, some of them having an enormous number in use, as shown in Table 14, which gives a list of all the towns which report 100 meters or over in use. These works, however, only number 31, with 36,111 meters in use, and 99 others with less than 100 meters have only 1,802, or an average of 18 each, while 157 water-works report no meters in use. Probably quite a number of these latter have more or less meters in use and have simply failed to report them, but all the towns having any large number of meters, we are confident, are included in our list.

A fact of even more significance than the absolute number of meters, however, is the proportion of meters to taps, and in the lower part of Table 14, this proportion is given for all the works having more than one-sixth of their taps metered, 22 in all. One town, Barrington, R. I., has all its taps metered,' but with the small number of 30 taps. Woonsocket, R. I., with 761 taps, has 88½ per cent. of them metered, and next comes Worcester, Mass., with 8,110 taps, of which 84.3 per cent. are metered. On the whole Worcester may be considered the banner town of New England, if not of the Union, in this respect, but several other large cities have a very large proportion of taps metered. Boston has 3,534 in use on both its systems, but the proportion to taps is still small. Providence, R. I., has the largest aggregate, 7,623, but the percentage to taps is only 58.1.

TABLE 14.

NEW ENGLAND WATER-WORKS REPORTING OVER 100 METERS IN USE.

	No. Meters.	To'l for State.
MAINE		
Portland	152	
Brunswick	210	
7 others	111	473
(33 without meters)		
NEW HAMPSHIRE		
Manchester	750	
10 others	108	858
(19 without meters)		
VERMONT		
Burlington	374	
4 others	15	389
(18 without meters)		
MASSACHUSETTS		
Boston	3,114	
Worcester	6,854	
Cambridge	219	
Boston (Mystic system)	420	
New Bedford	102	
Salem	138	
Fitchburg	600	
Lowell	1,430	
Lynn	236	
Attleboro	328	
Holyoke	149	
Fall River	2,941	
Brookline	156	
Lawrence	918	
Springfield	472	
Newton	2,370	
Taunton	782	
Brockton	1,200	
South Abington	130	
North Attleboro	200	
Whitman	126	
55 others	1,079	23,964
(57 without meters)		
RHODE ISLAND		
Providence	7,623	
Pawtucket	2,900	
Woonsocket	674	
6 others	144	11,341
(7 without meters)		
CONNECTICUT		
Hartford	315	
Norwich	100	
Waterbury	128	
17 others	345	888
(23 without meters)		
SUMMARY		
31 works with over 100 meters		36,111
99 " " under " "		1,802
157 " without "		
287		37,913

PERCENTAGE OF METERS TO TAPS IN VARIOUS NEW ENGLAND WATER-WORKS HAVING A LARGE NUMBER OF METERS, INCLUDING ALL THOSE WHICH HAVE MORE THAN ONE-SIXTH OF THEIR TAPS METERED.

Towns.	Per cent. of taps metered.	Towns.	Per cent. of taps metered.
Brunswick, Me.	100.0	Brockton, Mass.	57.1
Manchester, N. H.	24.2	S. Abington, "	52.0
Burlington, Vt.	16.7	N. Attleboro, "	42.4
Boston, Mass.	5.6	Whitman, "	63.0
Worcester, "	84.3	Middleboro, "	21.3
Fitchburg, "	27.2	Norwood, "	20.6
Lowell, "	19.2	Providence, R. I.	58.1
Attleboro, "	43.5	Pawtucket, "	60.4
Fall River, "	70.0	Woonsocket, "	88.5
Lawrence, "	21.2	Westerly, "	47.2
Newton, "	63.0	Barrington, "	100.0
Taunton, "	27.1	Hartford, Conn.	5.4

It has been discovered since this table was compiled that the report of 210 meters from Brunswick, Me., was an error. It has only 3 in use. This would correspondingly change the aggregates of the table.

HYDRANT RATES.

Table 15 gives a summary of these, so far as reported, for 110 water-works, which includes a large proportion of those which have such rates, being those works only controlled by private companies. The most common rates will be seen to be $30, $40, and $50, but 50 works out of the 110 report less than $30. The highest rates are in Maine, where they were doubtless given to encourage the construction of works.

TABLE 15.

NEW ENGLAND WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	Me.	N. H.	Ver't.	Mass.	R. I.	Conn.	Total.
Free	4	—	—	8	—	2	14
$ 5	—	—	1	—	—	—	1
10	—	—	1	5	—	—	6
15	1	1	1	4	1	3	11
20	—	1	—	7	—	3	11
25	—	2	—	3	—	2	7
30	1	1	2	5	2	6	17
35	1	3	1	3	—	—	8
40	5	—	—	6	—	2	13
45	1	—	—	3	—	—	4
50	8*	2	1	6	—	1	18
Total	21	10	7	50	3	19	110

* One of these Maine works received $63 and another $75 per hydrant.

PUMPS.

Table 16 shows fully the practice of the New England States in regard to pumps. The largest single pumping works by far is at Providence, R. I., where 5 engines have a combined pumping capacity of 33,000,000 galls. Nearly all of the larger works in this section are by gravity, but there are several very large pumping works, althoug

TABLE 16.

NEW ENGLAND WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically).	No. of Pumps.							Capacity, Millions of Gallons.						
	Me.	N.H.	Vt.	M'ss	R.I.	Ct.	T'tal.	Me.	N.H	Vt	Mass.	R.I.	Ct.	T'tal.
Blake	4	1	—	16	—	—	21	5.	1.0	—	15.2	—	—	21.4
Corliss........	—	—	—	—	4	—	4	—	—	—	—	20.0	—	20.0
Cornish	—	—	—	—	1	—	1	—	—	—	—	9.0	—	9.0
Davidson ...	—	1	—	5	—	—	6	—	5.0	—	7.5	—	—	12.5
Deane........	8	1	—	17	—	1	27	10.0	1.4	—	27.1	—	1.0	39.5
Holly-Gask'll	5	—	—	5	—	—	10	8.0	—	—	9.5	—	—	17.5
Knowles	—	1	1	11	2	—	15	—	0.1	0.4	15.0	4.0	—	19.5
Lang..........	—	3	1	—	—	—	4	—	5.5	1.0	—	—	—	6.5
Leavitt	—	—	—	2	—	—	2	—	—	—	10.0	—	—	10.0
McAlpine......	—	—	—	1	—	—	1	—	—	—	6.0	—	—	6.0
Morris.........	—	—	—	2	—	—	2	—	—	—	10.0	—	—	10.0
Nagle..........	—	—	—	—	1	—	1	—	—	—	—	5.0	—	5.0
Russell........	—	—	—	2	—	—	2	—	—	—	4.0	—	—	4.0
Wood	1	1	—	—	—	1	3	2.0	6.0	—	—	—	1.5	9.5
Worthington	8	3	2	40	5	4	62	6.6	5.0	1.5	96.7	9.0	5.0	123.8
Miscell'neous	3	1	3	8	3	3	21	1.0	—	3.4	3.9	4.1	15.5	27.9
Total......	29	12	7	109	16	9	182	32.8	24.0	6.3	204.9	51.1	23.0	342.1
No. of different works with pumps.	18	8	6	73	8	9	122	Three pumping works of trifling capacity are omitted, making 125 in all, against 130 gravity works.						

The miscellaneous class includes unknown also, the most important item in which is 2 pumps of 15,000,000 galls. capacity at New Haven, driven by water.

most of them are small. The aggregate pumping capacity of all the pumps in New England is only 342,100,000 galls., or less than the capacity of the new Croton Aqueduct alone, and it is to be remembered also, that on an average rather less than one-third of this capacity is in actual use.

The comparison by makers will be interesting to every engineer, and shows a great variety in use, with the Worthington far ahead of any single maker. It is to be remembered however, that this covers only a very small corner of the Union, and perhaps one-sixth of its water-works. Some of the pumps make much better relative showing in other sections. Considerably more than two-thirds of the total capacity is monopolized by six makes of pumps, the Worthington, Deane, Blake, Corliss, Knowles and Holly-Gaskill. The Davidson and Woods pumps come next, with about 10,000,000 capacity each, and 15 different makes in all are represented, not counting those with one pump each, included in miscellaneous.

RESERVOIR CAPACITY.

It is somewhat difficult to effectively summarize reservoir capacity since the natural requirements of different works vary greatly, and also the difficulty of obtaining a stored supply. Some small towns drawing from large lakes have several years' supply by natural storage. Others with supply pumped from abundant sources of natural supply and with duplicate pumps to insure against breakdowns, need and properly have but a very limited supply. Others again have urgent need of a large stored supply from lack of these advantages, and in many cases have been able to obtain it very easily by cheap dams.

Table 17 gives the facts in regard to reservoir and daily consumption for 66 water-works, including most of the more important. The last column is the most significant, giving the days supply stored, which ranges from 1,040 days in the case of Winchester, Mass., to 1.4 days supply at Cambridge, Mass., but here there are 4 pumps with a combined capacity of 5,000,000 galls. against a consumption of less than 4,000,000, and back of the pumps is a reservoir of 360,000,000 galls. containing over 90 days' supply, so that the mere "face of the returns" is not a fair criterion. The total storage capacity of a few of the cities is:

Boston, Mass., Main system	85	days.
" " Mystic "	54	"
Providence, R. I	25	"
Newport, "	10	"
Hartford, N. H	254	"
New Haven, Conn. (large supply back of pumps)	2	"
Worcester, Mass	300	"
Springfield, "	58	"
New Bedford, Mass	131	"
Fitchburg, Mass	236	"
Portland, Me	6	"

DAMS.

The highest and most important masonry dam (for water-works only) in New England is at New Haven, Conn., 500 ft. long by 38½ ft. high, 3 to 6 ft. thick on top and 27½ ft. at the bottom. The dam is of interest as having been successfully built on a very thin hard-pan stratum overlying quicksand by reinforcing it with concrete and sheet piling. At Norwalk, Conn., there is a short dam 230 ft. long and 32 ft. high, and at Greenfield, Mass.,a still shorter one, 60 ft. long by 35 ft. high. At Portland, Me., there is a considerable dam of unreported dimensions, costing $50,000. Otherwise than this there is no dam reported from New England over 150 ft long nor over 12 to 19 ft. high, and there are only some 24 reported in all.

TABLE 17.

NEW ENGLAND WATER-WORKS.—RELATIVE RESERVOIR CAPACITY AND CONSUMPTION OF 66 WORKS.

(Including the more important or significant works only.)

Water-works.	Storage capacity.	Daily consumption.	Days supply stored.
	Millions of gallons.		
MAINE			
Augusta	13.0	0.4	32.5
Biddeford	10.0	0.78	12.9
Brunswick	7.0	0.1	70.
Dover	3.0	0.02	150.
Gardiner	2.0	0.2	10.
Lewiston	5.0	1.6	3.1
Portland	30.0	5.0	6.
NEW HAMPSHIRE			
Claremont	29.0	0.15	193.
Great Falls	1.5	0.3	5.
Laconia	2.75	0.34	8.1
Nashua	4.0	1.5	2.7
Pittsfield	1.5	0.2	7.5
VERMONT			
Brattleboro	7.5	0.05	150.
Burlington	2.4	0.017	141.
Montpelier	4.25	0.9	4.5
St. Albans	100.0	0.5	200.
Winooski	5.0	0.16	31.2
MASSACHUSETTS			
Adams	10.0	0.8	12.5
Amesbury	5.0	0.1	50.
Beverly	3.2	1.0	3.2
Boston	2827.2	29.85	95.
"(Mystic)	41.2	7.63	14.
Brockton	330.0	1.	330.
Brookline	6.0	0.77	7.8
Cambridge	5.4	3.86	1.4
Chicopee	5.2	0.03	173.
Clinton	20.0	0.4	50.
Dalton	3.2	0.027	118.
Danvers	5.5	0.45	12.2
Fitchburg	289.0	1.183	236.
Gardiner	3.0	0.2	15.
Gloucester	10.0	0.4	25.
Greenfield	10.0	0.4	25.
Hyde Park	1.5	0.1	15.
Lawrence	40.0	2.5	16.
Lenox	0.7	0.45	15.5
Lowell	30.0	4.32	7.
Lynn	20.0	2.38	8.4
Nantucket	3.5	0.265	13.2
New Bedford	400.0	3.047	131.
Newton	15.	0.204	73.5
N. Adams	11.8	1.0	11.8
Northampton	20.5	0.15	137.
Pittsfield	0.6	0.2	3.
Plymouth	3.0	0.59	5.1
Revere	1.5	0.35	4.3
Salem	20.0	2.58	7.8
Springfield	230.6	4.00	57.7
Waltham	6.	0.6	10.
Westfield	184.	1.0	184.
Winchester	260.	0.25	1040.
Woburn	8.	0.87	9.2
Worcester	1200.	4.0	300.
RHODE ISLAND			
Newport	10.	1.0	10.
Pawtucket	21.	3.18	6.6
Providence	125.	4.92	25.4
CONNECTICUT			
Ansonia	10.	0.275	36.3
Hartford	1270.	5.0	254.
Meriden	300.	1.3	231.
New Haven	17.	8.8	1.9
Norwalk	4.5	0.7	6.4
Southington	64.	0.7	91.5
Stamford	7.0	1.0	7.
Torrington	71.0	1.0	71.0
Waterbury	9.0	1.5	9.
Willimantic	5.0	0.35	14.3

But one failure of a stone dam is reported, the first Cochituate dam for Boston, the failure being due to insufficient precautions against quicksand. It has been successfully renewed by careful sheet piling.

Practically all the New England water-works dams of any size are of earth, usually with a thin rubble masonry heart wall, a few only trusting to puddle walls. The most considerable water-works dam failure which ever occurred in New England, that at Hartford, Conn., appears to have been largely due to the use of a puddle instead of rubble heart wall. An excessive flood destroyed a partly built dam above and the rise of water soon cut away the dam down to the puddle, and in a few hours cut away the puddle as well, as narrated in full in the account of the Hartford water-works; but the dam was re newed with a puddle heart, and has stood well. Other earth dam failures have been at New Bedford, Mass., due to quicksand underlying a thin stratum of hard pan, and especially at Worcester, Mass., (Lynde Brook) where the waste gate became choked, and the dam failed by the gradual enlargement of old leaks, due to defective original construction, and especially an increase of height from 29 to 44 ft.

We have details of 63 earth dams of which the following are the more notable structures.

Cambridge, Mass, 1,100 ft. long by 85 ft. high, rubble heart wall.
Hartford, Conn., 728 ft. long by 53 ft. high, puddle heart.
" " 570 " " " 42½ " " "
(4 dams of about this size)
Springfield, Mass., 1,297 ft. long by 48 ft. high, rubble heart wall.
Fitchburg, Mass., 1,297 ft. long by 46 to 63 ft. high, rubble heart wall.
Fitchburg, Mass., 400 ft. long by 42 ft. high, rubble heart wall.
Newport, R. I., 2,800 ft. long by 15 ft. high, (sand).

Fully 50 of these dams use a carefully laid rubble masonry heart wall, of course in cement. The remainder use puddle walls.

We have reports of only two timber dams in New England, one at Bangor, Me., and one at St. Johnsbury, Vt., both insignificant structures, although that at Bangor is 900 ft. long.

TUNNELS.

The water-works tunnels in New England are few. We have reports of one at Bridgeport, Conn., 2,700 ft. long, one at Lowell, Mass., 733 ft., one at Fairhaven, Vt., 150 ft. long, and several on the Boston water-works of considerable length, the aggregate of which is not reported.

NEW PROJECTS.

We have details of the following works as projected with fair prospect of early construction.

Maine	11
Mew Hampshire	2
Vermont,	0
Massachusetts	5
Rhode Island	4
Connecticut	3
Total New England	25

This will be an addition of about 9 per cent. to the existing water-works; and while some are likely to fall through, a large proportion of them are likely to be completed during the year 1889.

THE WATER-WORKS OF THE MIDDLE STATES.

The water-works of the Middle States are an immense interest, larger even than those of the New England States, and much larger than those of any other group of States. In the aggregate $156,522,264 are invested in 433 works, against $84,992,725 in 287 works in New England.

As in New England, the great majority of the water-works are of very recent construction,

TABLE 1—B.

MIDDLE STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.			YEAR.	Water-Works Built.		
	Main.	Subsidiary.	Total.		Main.	Subs.	Tot
Before 1800	3	....	3				
1800-10	6	....	6	1871	16	....	16
1811-20	1	....	1	1872	12	....	12
1821-30	5	....	5	1873	12	....	12
1831-40	3	....	3	1874	12	1	13
1841-50	12	....	12	1875	13	2	15
1851	3	....	3	1876	12	1	13
1852	4	....	4	1877	4	1	5
1853	2	....	2	1878	11	....	11
1854	3	....	3	1879	13	....	13
1855	2	....	2	1880	8	....	8
1856	3	....	3	1881	10	....	10
1857	5	1	6	1882	14	6	20
1858	2	....	2	1883	22	3	25
1859	5	....	5	1884	23	3	26
1860	4	....	4	1885	24	1	25
1861	2	....	2	1886	28	2	30
1862	....	....	....	1887	33	1	34
1863	....	....	....	1888	28	3	31
1864	1	....	1	Unknown.	15	2	17
1865	2	....	2	Total	406	27	433
1866	3	....	3				
1867	5	....	5	Total New England	254	32	286
1868	6	....	6				
1869	4	....	4				
1870	10	....	10				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems.

Elmira, N. Y. (1861) omitted.

TABLE 2—B.

MIDDLE STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Subsidiary Water-Works are indicated by numerals in parenthesis.]

DATE	Water-Works Built in					Total Main works.	Total Main and Subs.	Totals N. E. States.
	N. Y.	N. J.	Penn.	Del.	Md. & D. C.			
Before 1800	1	1	1	....	....	3	3	1
1800-10	....	2	2	1	1	6	6	2
1811-20	....	....	1	....	....	1	1	2
1821-30	1	....	4	....	....	5	5	1
1831-40	1	....	2	....	....	3	3	3
1841-50	3	1	8	....	....	12	12	3
1851-55	6	3	4	....	1	14	14	9
1856-60	6	4	(1) 8	....	1	(1) 19	20	7
1861-65	2	1	2	....	....	5	5	6
1866-70	11	....	15	1	1	28	28	23
1871-75	25	(1) 3	(2) 3[illegible]	....	1	(3) 65	68	39
1876-80	(1) 20	8	(1) [illegible]	....	1	(2) 48	50	38
1881-85	(3) 41	(9) 13	(1[illegible]	1	4	(13) 93	106	72
1886-88	(4) 49	(1) 12	([illegible] 37	1	5	(8) 104	112	78
Total	(8) 166	(11) 48	(8) 173	4	15	(27) 406	433	286

Included in the total of 1886-88 are the following water-works of unknown dates, nearly all of which are known to belong to this period: New York 6, New Jersey 1 (subsidiary), Pennsylvania 8 main and 2 subsidiary works.

Elmira, N. Y. (1861) omitted.

TABLE3—B.

MAIN DETAILS OF THE MIDDLE STATES WATER-WORKS BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of Works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the condition of the works at that date, but merely as the *present condition* of works then existing.]

DATE.	Present Pop'n Supplied	No. of Works			Present Finances.		Miles of Mains.	Number of		
		Independent.	Subsidiary.	Total.	Cost.	Rev.		Taps.	Hdr'ts	Meters.
					NEW YORK.					
1787-50	1,446,669	6	....	6	$42,678,192	$3,120,920	783.68	190,691	9,388	19,966
1851-60	889,963	12	....	12	18,899,071	1,996,417	868.55	125,457	7,116	2,251
1861-70	129,961	13	...	13	2,619,376	262,597	207.45	13,736	1,789	1,211
1871-80	287,364	45	1	46	8,756,120	754,016	622.50	37.784	4,779	3,501
1881-85	170,616	41	3	44	4,439,790	493,207	452.61	15,564	2,762	311
1886-88	129,157	43	4	47	3,470.664	365,115	283.00	5,078	1,895	181
Unkno'n	8,474	6	....	6	81,500	8,625	8.75	599	52	11
Total	3,062,204	166	8	174	$80,944,713	$7,000,897	3226.54	388,909	27,781	27,432
					NEW JERSEY.					
1799-50:	176,457	4	....	4	$3,382,526	$ 413,351	229.00	21,559	1,689	730
1851-60	279,450	7	....	7	8,819,000	1,028,200	416.16	31,903	3,428	2927
1861-70	1,751	1	....	1	50,000	11 000	10.00	350	13	—
1871-80	68,761	11	1	12	1,545,265	159,299	120.50	6,710	812	90
1881-85	85,531	13	9	22	1,625,500	231,677	159.25	5,914	1,075	974
1886-88	26,863	12	....	12	652,000	101,500	97.96	2,732	655	88
Unkno'n	5,437	....	1	1	—	—	—	—	—	—
	644,250	48	11	59	$16,074,291	$ 1,945,027	1032.87	69,168	7,672	4809
					PENNSYLVANIA.					
1761-50	1,241,879	18	—	18	$25,118,847	$3,121,917	1168.90	244,115	11,047	389
1851-60	101,707	12	1	13	2,093,000	286,715	230.30	15,057	844	85
1861-70	148,176	17	—	17	3,562,929	293,136	258.37	19,142	997	97
1871-80	215,898	55	3	58	3,927,825	462,076	440.95	30,578	2,243	179
1881-85	89,693	34	1	35	1,796.402	214,736	147.05	10,327	1,295	150
1886-88	64,063	29	1	30	1,951,578	210,530	210.75	5,798	982	12
Unkno'n	13,772	8	2	10	75,000	11,065	15.05	677	92	—
Totals	1,875,188	173	8	181	$38,525,581	$4,600,175	2,471,37	325,694	17,500	912
					DELAWARE.					
1804-50	42,478	1	...	1	$760,000	104,536	69.50	10,869	625	7
1851-60	....	....		......	....	....	......	....	....	....
1861-70	3,700	1	....	1	112,000	8,000	8.50	507	40	....
1871-80	....	....	....	....	....	....	......	....	....	....
1881-85	2,811	1	....	1	23,000	3,200	3.75	240	29	7
1886-88	2,423	1	....	1	24,000	2,420	3.00	240	31	....
Totals	51,412	4	....	4	919,000	118,156	84.75	11,856	725	14
					MARYLAND and District of Columbia.					
1807-50	332,313	1	....	1	10,886,979	792,100	358.00	66,089	1,062	784
1851-60	151,350	2	...	2	8,522,000	501,850	132.00	22,355	1,040	....
1861-70	6,642	1	....	1	65,000	12,290	9.50	1,000	45	6
1871-80	19,352	2	....	2	220,000	17,000	60.00	3,300	30	....
1881-85	14,300	4	....	4	210.000	15,700	30.50	1,115	162	25
1886-88	8,607	5	...	5	154,700	22,466	22.50	535	78	9
Total	532,564	15	....	15	20,058,679	1,361,406	612.50	94,394	2,417	824

[1 Water-works (Washington) in Dist. of Columbia, opened 1859.]

TABLE 4.—B.

MIDDLE STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3.

State.	Pop'n on Water-Works 1880 census.	No. of Works.			Present Finances.		Miles of Mains.	Number of		
		Main.	Subs.	Total.	Cost.	Revenue		Taps.	Hy-dr'ts	Me-ters.
New York	3,062,204	166	8	174	$80,944,713	$7,000,897	3,226.54	388,909	27,781	27,432
New Jersey	644,250	48	11	59	16,074,291	1,945,027	1,032.87	69,168	7,672	4,809
Pennsylvania	1,875,188	173	8	181	38,525,581	4,600,175	2,471.37	325,694	17,500	912
Delaware	51,412	4	..	4	919,000	118,156	84.75	11,856	725	14
Maryland	385,271	14	..	14	11,558,679	861,406	484.50	72,299	1,404	824
(Dist. Col.)	147,293	1	..	1	8,500,000	500,000	128.	22,095	1,013	
Total Middle	6,165,618	406	27	433	$156,522,264	15,025,661	7,428.03	890,021	56,095	33,991
Total N. Eng.	2,409,359	255	32	287	84,992,725	6,412,624	5,290.70	315,404	32,300	37,913

Elmira, N. Y., pop., 20,541, cost $522 000, revenue, $10,000, 40 miles of mains, 150 taps, 300 meters, 224 hydrants, omitted. See Appendix.

This omission would make a corresponging change of 1 works in all the following tables. It has a surface and river supply pumped to reservoir.

Only 1 water-works, Washington, in District of Columbia.

TABLE 5—B.

MIDDLE STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL MIDDLE STATES WATER-WORKS, AS GIVEN IN TABLE 3.

DATE.	Present pop'n of water-works.	No. of Works.			Present Finances.		Miles of mains.	Number of		
		Main.	Subsid-iary.	Total.	Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
1798-1850	3,239,796	30	......	30	$82,826,544	$7,552,824	2,609.08	533,323	23,811	21,876
1851-60	1,422,470	33	1	34	38,333,071	3,813,182	1,647.01	194,772	12,428	5,263
1861-70	290,230	33	.....	33	6,409,305	587,023	493.82	34,735	2,884	1,314
1871-80	591,375	113	5	118	14,449,210	1,392,391	1,243.95	78,372	7,864	3,770
1881-85	362,951	93	13	106	8,094,892	958,520	793.16	33,160	5,323	1,467
1886-88	231,113	90	5	95	6,252,942	702,031	617.21	14,383	3,641	290
Unkno'n	27,683	14	3	17	9,156,500	19,690	23.80	1,276	144	11
Total	6,165,618	406	27	433	156,522,264	15,025,661	7,428.03	890,021	56,095	33,991

N. B.—This table does not represent the status of the works at the several dates (except as to number) but the statistics for the *current year* of works first opened at the several dates.

Table 1-B shows that there were constructed:

	Middle States.	N.Eng
Before 1850, a total of	30	12
Decade ending 1860	34	16
" " 1870	33	32
" " 1880	118	76
7½ years " 1888	218	150
A total of	433	286

Thus a fraction over one-half of the water-works of the Middle States, as of New England, have been built in the last 7½ years, and 26 per cent. of them have been built within the last 2½ years, against 27 per cent. in New England, a singular constancy of ratio. Before 1850, however, the Middle States led considerably.

The capital invested in water-works as compared with railways ears a much less ratio than in New England, because the railway valuations of the Middle States are so enormous, being paid tribute to by the entire country. The nominal value (stocks and bonds) of the Middle States railways is $2,154,279,370 or in the ratio of 13.75 to 1 against only 4.12 to 1 in New England. Reducing this to a cash valuation, however, the real ratio will hardly be more than 6 or 7 to 1 in the Middle States against 2½ or 3 to 1 in New England.

In miles of water mains and railways the comparison stands as follows:

	Miles of Water mains.	Miles of Railways.
New York	3,227	7,552
New Jersey	1,033	,907
Pennsylvania	2,471	7,599
Delaware	85	254
Maryland	612	1,350
Total	7,428	18 662

There are 2.51 times as many miles of railway as of water mains in the Middle States, against only 1.26 times in New England. Few would imagine that the aggregates were so nearly equal in either section.

It is to be borne in mind in examining Tables 3 and 5, that as we stated in reviewing the New England water-works, it is impossible for us this year to show the actual status of water-works at the end of each decennial period. The most we can do in this issue is to show the *present* status of the works *first opened* in each decade. Thus all the increase in the earlier works, which is usually far greater than the whole original investment and plant, is credited to the decade when the works were first opened.

TABLE 6.—B.

MIDDLE STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.
[The "town population" is in towns of 4,000 inhabitants or over.]

States.	Total Population. 1870	Total Population. 1880	Inc. per cent.	"Town Population 1880.	No. of towns over 4,000.	Per cent. of total.	Pop'n on Water-works, 1888. Tot'l 1888 pop'n.	P. C. of Total pop'n.	P. C. of Town pop'n.	Av. pop'n on each Water works. Main works only.	Av. pop'n on each Water works. Main & sub w'ks together.
N. Y.	4,382,757	5,082,871	15.9	2,726,367	58	53.7	3,062,204	60 2	123.0	18,420	17,600
N. J.	906,096	1,131,116	24.8	586,547	28	51.8	644,250	57.0	109.8	13,400	10,900
Penn.	3,521,951	4,282,891	21.6	1,658,523	56	38.7	1,875,188	43.8	132.0	10,810	10,350
Del.	125,015	146,608	17.2	42,478	1	28.9	51,412	35 1	121.0	12,850	12,850
Md.	780,894	934,943	19.7	364,943	5	39.0	385,271	41.2	105.8	27,500	27,500
D. C.	131,700	177,624	34.8	159,871	2	89.9	147,293	83.0	92.0	147,293	147,293
Total Middle S.	9,848,413	11,756,053	19.4	5,538,729	150	47.2	6,165,618	52.5	113.1	15,190	14,220
Total N. E. States	3,487,924	4,010,529	15.0	1,989,339	114	49.6	2,409,359	59.8	120.6	9,441	8,391

New York, apart from	New York and Brooklyn	7,490
Pennsylvania "	Philadelphia	5,700
Maryland "	Baltimore	4,060
Massachusetts "	Boston	8,400

Compare also Table 13.

The population statistics given in Table 6-B are perhaps the most interesting of all. They show that 52.5 per cent. of the total population against 59.8 in New England are on water-works. The total census town population (in towns of 4,000 or over) is 47.2 per cent. instead of 49.6 per cent., and the percentage of this *town* population supplied is 113.1 against 120.6 per cent., indicating that in the Middle as in the New England States, more than the total population in towns of 4,000 or over is supplied, as we shall probably find to be the case throughout the United States. The increase of total population has been slightly greater than in New England, 19.4 against 15 per cent., accounting in part for the late more rapid progress of water-works.

TABLE 7.—B.

MIDDLE STATES—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1,000 or under.	1,000 to 3,000.	3,000 to 5,000.	5,000 to 10,000.	10,000 to 20,000.	20,000 or over.	Total No.
New York	20	68	33	28	12	13	174
New Jersey	7	18	9	16	2	7	59
Pennsylvania	18	81	33	31	9	9	181
Delaware	....	2	1	....	....	1	4
Mary'd & D.C.	2	5	2	3	1	2	15
Total Middle S	47	174	78	78	24	32	433
Total New Eng.	40	80	65	48	35	19	287

The percentage of water-works in towns of various sizes is:

	Towns of Under 1,000	1,000 to 3,000	3,000 to 5,000	5,000 or over	Total
Middle States	10.9	40.2	18.0	30.9	100.0
New England	13.9	27.8	22.6	35.7	100.0

TABLE 8—B

MIDDLE STATES WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

	Cost per			Revenue per			Population on water-works.		P. C. rev. to Cost.
	head on water-works.	mile of main.	tap.	head on w'ter w'ks.	mile of main	tap.	per tap.	per eter	
New York......	$26.40	$25,100	$207	$2.28	$2,170	$18.00	7.9	112	8.65
New Jersey....	24.90	15,590	232	3.02	1,885	28.10	9.3	134	12.10
Pennsylvania ..	20.50	15,580	118	2.45	1,860	14.12	5.7	2040	11.92
Delaware	17.85	10,820	77	2.29	1,393	10.00	4.3	3660	12.84
Maryland	29.90	23,800	160	2.23	1,775	11.90	5.3	467	7.45
Dist. Columbia.	57.80	66,400	385	3.40	3,900	22.60	6.6	....	5.88
Av. Middle Sts.	25.40	21,000	176	2.43	2,023	16.90	6.9	181	9.40
Av. New Eng.	35.30	16,080	269	2.66	1,273	20.30	7.6	63	7.54
N. Y. W. W'ks.	33.10	64,500	222	2.23	4,350	14.96	6.7	67	6.74
Phila. "	17.73	17,120	92	2.40	2,315	12.40	5.2	3340	13.55
Baltimore "	32.75	30,450	165	2.38	2,215	11.95	5.0	424	7.27
Boston..........	53.90	44,700	352	3.52	2,920	23.10	6.6	117	6.52

Thus a larger proportion of the Middle States water-works are in towns of under 5,000 than in New England; and this is the fairest test of comparative enterprise and progress.

Table 8-B gives some very interesting financial statistics, from which it will appear that the investment per head and per tap (of population on water-works) is considerably smaller than in New England, but the cost per mile of main large. The revenue per head is singularly constant at about $2.50 per tap, a little less because of a fractionally smaller population per tap (6.9 instead of 7.6); and per main, much larger, owing to a larger number of taps per mile of main. The average gross earnings of water-works are 9.4 per cent., against 7.54 in New England. New Jersey, Pennsylvania, and Delaware show the large rate of 12 per cent., being much higher than any New England State.

Table 9-B shows that the proportion of gravity works is somewhat less than in New England, 42.4 against 50.4 per cent. Direct pumping works are nearly 4 times as numerous but still not common, being only 40 (chiefly in New York) out of 233. Stand-pipes and tanks are rather less common than in New England. It is a singular fact that the percentage of gravity works is larger in New York than in Pennsylvania, a much more hilly State. Evidently New York has been willing to spend more money on its works, for it is a notable fact that, although Pennsylvania has 7 more works, (173 against 166) the New York investment in water-works is more than double; $80,944,713 against $38,525,581, and the miles of mains also a third larger.

TABLE 9-B.

MIDDLE STATES WATER-WORKS.—KIND OF WORKS.

STATE	Gravity	Pumping to				Unkno'n	Total	P. C. gravity works.
		Reservoir.	Tank.	Stand-Pipe	Direct.			
New York	80	33	13	17	26	1	170	47.0
New Jersey	10	16	4	14	3	1	48	20.8
Pennsylvania	79	60	15	10	9	2	175	45.1
Delaware	....	2	....	1	1	....	4	0.0
Md. and D. C.	6	5	1	2	1	....	15	40.0
Total Middle S	175	116	33	44	40	4	412	42.4
Total N. Eng.	130	50	21	31	21	5	258	50.4

As some of the works have a double system, the totals exceed that of Table 4-B. Several other gravity works have small auxiliary pumping systems for special service which have been disregarded, and others have small or very rarely used auxiliary systems which have been disregarded.

In classifying the pumping works, only those have been regarded as pumping "direct" which pump their ordinary supply thus. Many if not most of the pumping works have arrangements to pump direct in case of fire, as is shown in part in Table 12-B.

SOURCES OF SUPPLY.

Table 10-B, giving sources of supply, shows some interesting contrasts with the New England States, especially in the number of works supplied from lakes and ponds. In Pennsylvania and Maryland there is not a single works supplied from lakes, except 2 which draw from Lake Erie, the reason being that there are no lakes to draw from. In New York there are only 15 against 70 in New England. Lakes are a phenomenon due to incomplete erosion or to gravelly deposits due to ice action, and occur in large numbers only in northern latitudes. In British America, as we have noted in another article in this issue, there are tens of thousands; in northern New England, Michigan, Wisconsin and Minnesota; there

TABLE 10-B.

MIDDLE STATES WATER-WORKS—SOURCES OF SUPPLY.

STATE.	S'rface	Spr'gs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
New York.....	20	43	12	31	15	20	27	2	170
New Jersey.....	3	6	9	15	*1	3	11	....	48
Pennsylvania...	10	50	22	39	2	35	13	2	173
Delaware.....	....	....	....	....	....	2	2	....	4
Md. and D. C....	1	4	1	4	....	1	5	......	16
Total Middle S	34	103	44	89	18	61.	58	4	411
Per cent......	8.3	25.1	10.7	21.6	4.4	14.8	14.1	1.0	100.0
do. New Eng.	14.0	17.4	16.3	14.0	27.1*	....	7.7	3.5	100.0

* Including 14.7 per cent. of so called "ponds", really lakes.

The totals exceed slightly the total number of works, as some works have a double source of supply. Where the second source of supply is of quite minor importance, however, it has been generally disregarded. One "canal" supply in New York has been classed with surface water.

TABLE 11-B.

AVERAGE WORKING PRESSURES OF MIDDLE STATES WATER-WORKS.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence considerably higher than the effective pressure.]

PRESSURE lbs. per sq. in.	N.Y.	N. J.	Pa.	Del.	Md. and D. C.	Total	Total N. E.
Under 20	2	1	3	1	....	7	1
20-29	4	5	8	1	1	19	3
30-39	7	10	13	....	2	32	18
40-49	19	15	15	1	1	51	24
50-59	14	5	20	1	2	42	35
60-69	21	3	20	....	2	46	34
70-79	18	4	23	....	....	45	37
80-89	24	2	15	....	1	42	19
90-99	11	....	9	....	4	24	23
100-109	8	....	7	....	1	16	6
110-119	6	....	8	....	....	14	3
120-129	4	....	9	....	....	13	8
130-139	2	....	1	....	....	3	1
140-149	1	....	....	....	....	1	1
150-159	2	....	3	....	....	5	1
160-169	....	1	1	....	....	2	
170-179	1	....	2*	....	....	3	1
Total works reporting	144	46	157	4	14	365	215
Av. pressure lbs.	72.5	47.4	71.8	28.0	65.9	68.3	72.5

*Said to be over 200 lbs. pressure.

are likewise thousands, but very few elsewhere on this continent. Wells are much more largely used in the Middle States than in New England, and surface supply less. Rivers and creeks supply 36 per cent. of the works against 14 per cent. in New England.

WORKING PRESSURES.

Table 11-B shows that these average somewhat lower than in New England (68.3 against 72.5 lbs.) due chiefly to a low average of 47.4 lbs. in New Jersey. About 60 per cent. of the works range between 40 and 80 lbs., but there are many which range much higher, most of the larger works being lower. The fire pressures, given in Table 12-B, call for no special remark. There are 30 per cent. of the works in all which use higher pressures.

TABLE 12-B.

FIRE PRESSURE OF MIDDLE STATES WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE lbs. per sq. in.	N. Y.	N. J.	Pa.	Del.	Md. and D. C.	Total	Total N. E.
	....	....	2	....	....	2	3
40-49	....	4	....	....	1	5	2
50-59	5	4	3	....	....	12	2
60-69	6	1	5	....	....	12	5
70-79	7	3	7	1	....	18	7
80-89	2	....	7	....	....	9	11
90-99	9	1	5	1	1	17	3
100-109	1	3	2	....	....	6	6
110-119	9	2	3	....	3	17	3
120-129	5	....	3	....	....	8	2
130-139	2	....	2	....	....	4	4
140-149	5	....	4	....	1	10	1
150-159	1	....	....	....	....	1	....
160-169	....	....	....	....	....	.....	
170-179	2	....	1	....	....	3	....
Total works reporting.	54	18	44	2	6	124	50

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE

10 lbs. or under	1	4	8	....	....	13	8
10-19	4	3	5	....	1	13	7
20-29	8	1	5	....	1	15	7
30-39	4	....	4	....	1	9	10
40-49	10	4	6	2	....	22	6
50-59	5	1	1	....	2	9	3
60-69	7	2	4	....	....	13	4
70-79	4	....	5	....	1	10	5
80-89	7	3	3	....	....	13	1
90-99	1	....	....	....	....	1	....
100-109	2	....	2	....	....	4	....
110-119	1	....	....	....	....	1	....
120-129	....	....	1	....	....	1	1
Total works reporting	54	18	44	2	6	124	52

OWNERSHIP OF THE WORKS.

Table 13-B gives these statistics, showing that 4,829,527 out of 6,165,618 population on water-works in the Middle States are supplied by 137 public works, leaving only 1,336,091 to be supplied by the remaining 271 private works, an average of 4,930 per private work against 3,980 in New England. In all, 78.3 per cent. of the Middle

TABLE 13—B.

OWNERSHIP OF MIDDLE STATES WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	N. Y.	N. J.	Pa.	Del.	Md. & D. C.	Total.	Total N. Eng.
City or town	69	20	41	3	4	137	119
Local company	87	25	124	1	11	248	149
Outside company	1	—	—	—	—	1	9
Individuals	11	2	6	—	—	19	8
Unknown	—	1	2	—	—	3	2
Total No.	168	48	173	4	15	408	287
Population supp'd by public works	2,594,398	409,453	1,279,006	47,712	498,958	4,829,527	1,740,574
Total pop'n on W. W's.	3,062,204	644,250	1,875,188	51,412	532,564	6,165,618	2,409,359
P. C. supplied by city works	84.7	63.5	68.1	92.6	93.9	78.3	72.3
Pop'n on private w'ks.	467,806	234,797	596.182	3,700	33,606	1,336,091	668,785
Pop'n per private w'k.	4,725	8,380	4,510	3,700	3,055	4,930	3,980
P. C. of total city pop'n supp'd by p'blic w'ks.	95.3	69.9	77.0	112.0	136.6	85.2	87.5

States water-works population are supplied by public works, against 72.3 in New England. Almost precisely the same per cent. of the census city (over 4,000) population (85.2 against 87.5 per cent.) are supplied by public works.

Maryland shows up very well, the best of all the 5 States, in the degree to which water-works have been carried into small towns

TABLE 14-B.

MIDDLE STATES WATER-WORKS REPORTING OVER 100 METERS IN USE.

	No. Meters	Total for State.
NEW YORK.		
New York	18,000	
Syracuse	400	
Utica	1,500	
Brooklyn	2,021	
Auburn	400	
Binghamton	203	
Elmira	300	
Poughkeepsie	530	
Rochester	1,500	
Yonkers	1 538	
Irvington	100	
New Rochelle	120	
Flushing	140	
55 others	1,035	27,787
(107 without meters)		
NEW JERSEY		
Morristown	250	
Newark	432	
Jersey City	217	
Hoboken	2,667	
Bayonne City	500	
East Orange	150	
Princeton	220	
19 others	373	4,809
(33 without meters)		
PENNSYLVANIA		
Philadelphia	253	
McKeesport	120	
44 others	539	912
(135 without meters)		
MARYLAND and D. COL'B'A		
Baltimore	784	
6 others	40	824
(8 without meters)		
DELAWARE		
2 works	14	
SUMMARY		
23 works with over 100 meters		32,345
124 " " under " "		2,001
287 " " no "		....
433 works in all		34,346
130 New England works have		37,913

See also Table 14½-B. Elmira included in this table, but not in the preceding.

having a population of only 3,055 per private works, against about 4,600 in New York and Pennsylvania, and 3,470 in Massachusetts.

TABLE 14,B.

PERCENTAGE OF METERS TO TAPS IN VARIOUS MIDDLE STATES WATER-WORKS HAVING A LARGE NUMBER OF METERS, INCLUDING ALL THOSE WHICH HAVE MORE THAN ONE-SIXTH OF THEIR TAPS METERED.

Towns.	Per cent. of taps metered.	Towns.	Per cent. of taps metered.
New York, N. Y.	10.0	Elmira, N. Y.	20.0
Syracuse, “	16.0	Morristown, N. J.	31.2
Utica, “	57.7	Newark, “	3.5
Brooklyn, “	2.5	Hoboken, “	48.0
Poughkeepsie, “	29.6	Bayonne City, “	95.3
Flushing, “	15.6	East Orange, “	18.7
College Point, “	16.7	Perth Amboy, “	20.2
Rochester, “	13.6	Princeton, “	91.2
Yonkers, “	72.3	Red Bank, “	29.3
Irvington, “	100.0	Dover, “	40.0
Waterford, “	17.6	Philadelphia, Pa.	0.15
New Rochelle, “	84.6	Baltimore, Md.	1.2

Vermont's remarkable record of only 1,930 inhabitants per private work, however, is not approached in the Middle States.

USE OF METERS.

Table 14-B shows that the use of meters is far less common in the Middle than New England States, there being only 33,991 in all against 37,913; 18,000 of these are in New York alone, he number remaining being divided in small lots, for the most part, among large number of works. Pennsylvania seems to have a surprisingly poor opinion of meters, or an extra abundant water supply, the number in use being only 912; 253 of them in Philadelphia.

TABLE 15-B

MIDDLE STATES WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	N. Y.	N. J.	Pa.	Md.	Total.	Total N.E.
Free	......	3	8	......	11	14
$ 5	......	1	6	1	8	1
10	......	......	8	2	10	6
15	2	2	10	2	16	11
20	2	......	7	1	10	11
25	2	4	5	2	13	7
30	5	1	4	......	10	17
35	5	1	3	......	9	8
40	12	1	4	......	17	13
45	5	2	1	......	8	4
50	8	3	9	......	20	16
55	1	......	......	......	1	......
60	4	1	......	......	5	1
75	1	......	......	......	1	1
90	1	......	......	......	1	......
100	1	......	......	......	1	......
Total	49	19	65	8	141	110

The above includes all the works which report a hydrant rental separately. Nearly all the private works receive an indirect rental of some stated sum including water supply of city buildings, etc.

HYDRANT RATES.

Table 15-B shows the hydrant rates so far as reported to the nearest $5. They will be seen to range somewhat higher than in New England, some ranging very high. In Pennsylvania there are many very low rates, doubtless, due to the abundance of supply and low average cost of the works. Many towns which do not pay a specific hydrant rental pay one in effect by specified large payments for all city water supply. These cases it is impossible to take account of.

PUMPS.

Table 16-B will perhaps be examined with more interest than any other, by a certain class of our readers at least. The Worthington maintains the large lead which it had in New England, but the Holly-Gaskill is a good second, and far ahead, relatively, of its New England showing. The "miscellaneous" includes a large amount of water-power pumping, including not less than 33,300,000 galls. daily in Philadelphia alone. The Philadelphia pumping plant, being the largest in the country, has a special interest. It consists of

TABLE 16.—B.

MIDDLE STATES WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically.	No of Pumps.						Capacity, millions of gallons.						
	N. Y.	N. J.	Pa.	Del	Md.& D.C.	Total	N. Y.	N.J.	Pa.	Del	Md.& D.C.	Total	Total N. E.
Blake..........	3	6	6	1	—	16	3.1	19.5	2.7	0.8	—	26.1	21.4
Cameron......	—	—	4	—	—	4	—	—	1.6	—	—	1.6	—
Corliss........	—	—	2	1	—	3	—	—	12.0	10.0	—	22.0	20.0
Cornish	—	2	4	—	—	6	—	9.0	10.3	—	—	19.3	9.0
Davidson	7	1	2	1	1	12	21.5	3.0	2.0	1.8	0.4	28.7	12.5
Deane..........	6	—	6	—	2	14	12.5	—	6.4	—	0.5	19.4	39.5
Galloway	—	1	—	—	—	1	—	6.0	—	—	—	6.0	—
Gordon & Maxwell	2	2	3	2	—	9	1.4	3.0	3.3	0.8	—	8.5	—
Holly-Gaskill	37	6	9	2	4	58	122.0	3.3	23.6	1.0	7.0	156.9	17.5
Knowles.. ..	7	1	19	—	—	27	6.5	0.1	25.5	—	—	32.1	19.5
Lang..........	4	—	1	—	—	5	8.0	—	0.2	—	—	8.2	6.5
Lowry	—	—	5	—	—	5	—	—	90.0	—	—	90.0	—
Volker & Felt'n	3	—	—	—	—	3	5.5	—	—	—	—	5.5	—
Wetherill	—	1	2	—	—	3	—	2.0	10.0	—	—	12.0	—
Wood	5	—	—	—	—	5	6.0	—	—	—	—	6.0	9.5
Worthen	1	1	—	—	—	2	5.0	0.5	—	—	—	5.5	—
Worthington..	37	39	51	1	5	133	96.2	103.8	131.0	5.0	8.6	344.6	123.8
Wilson & Snyder..........	—	—	4	—	—	4	—	—	6.6	—	—	6.6	—
Miscellaneous	30	12	49	—	3	94	79.0	26.8	104.7	—	1.7	212.2	62.9
Totals.	142	72	167	8	15	404	366.7	177.0	439.9	19.4	18.2	1011.2	342.1

At Elmira is a 6,000,000 Worthington and 3,000,000 Knowles pump not included above.

	Galls. daily.
Water-power	33,300,000
10 Worthington pumps	77,000,000
1 Holly-Gaskill	20,000,000
2 Marine compound	30,000,000
1 Corliss	10,000,000
1 Simpson	8,000,000
1 Cornish	2,250,000
2 Davidson	2,000,000
3 Knowles	750,000
Total daily capacity	183,300,000

Of this aggregate only 88,850,000 galls. is now regularly used.

RESERVOIR CAPACITY.

Table 17-B gives the facts in regard to reservoir and daily consumption for 76 water-works, including most of the more important ones. We may note here that we are obliged to omit for this year and next any tabulation of the consumption of water per inhabitant for the reason that the actual size of the population supplied is so uncertain, the last authentic statistics being for 1880 in most cases, or 8 years old.

TABLE 17-B.

MIDDLE STATES WATER-WORKS.—RELATIVE RESERVOIR CAPACITY AND CONSUMPTION OF 66 WORKS.

(Including the more important or significant works only.)

Water-works.	Storage capacity	Daily consumption.	Days supply stored.
	Millions of gallons.		
NEW YORK			
Albany	216.7	9.0	24.1
Amsterdam	90.0	.166	54.0
Attica	12.0	.225	53.3
Brooklyn	1,180.0	46.27	25.5
Cambridge	7.0	.004	175.
Chatham	1.5	.15	10.0
Cohoes	92.0	3.0	30.7
Fonda	2.0	0.1	20.0
Fredonia	8.0	0.05	160.
Gloversville	15.0	0.5	30.0
Goshen	46.0	0.25	184.0
Hornellsville	50.0	0.8	62.5
Hudson	3.2	1.3	2.5
Johnston	10.0	0.5	20.0
Little Falls	26.0	4.0	6.5
Middletown	300.0	0.9	333.
Newburgh	2.0	2.0	1.0
New York	18,325.	110.0	166.6
Peekskill	37.0	0.28	132.
Port Jervis	275.0	1.0	275.
Richfield Springs	9.0	0.5	18.0
Rochester	65.6	7.2	9.1
Sherburne	10.0	0.03	333.3
Syracuse	80.0	6.0	13.3
Troy	531.0	8.0	66.5
Utica	800.0	3.0	266.7
Watertown	3.25	2.0	1.6
Waverly	58.0	0.5	116.
Yonkers	00	1.57	254.
NEW JERSEY			
Camden	7.5	5.3	1.4
Gloucester City	2.0	.075	2.7
Jersey City	237.0	16.5	14.4
Lambertville	22.0	0.25	88.
Morristown	16.0	.275	58.2
Mt. Holly	0.6	0.2	3.0
Newark	46.0	12.6	46.5
New Brunswick	15.0	1.08	13.9
Orange	375.0	1.0	375.
Paterson	50.0	8.0	6.2
Perth Amboy	20.0	0.35	57.0
PENNSYLVANIA			
Allegheny	18.0	17.8	1.0
Allentown	.41	2.0	0.2
Altoona	63.0	.175	359.
Ashland	3.8	.35	10.9
Beaver Falls	3.0	2.5	1.2
Bellefonte	.29	.30	1.0
Blairsville	.20	.16	1.2
Bradford	24.0	1.12	21.4
Conshohocken	1.25	.175	7.3
Easton	5.0	1.5	3.3
Erie	30.0	3.34	9.0
Franklin	17.0	0.80	21.2
Harrisburg	20.0	6.4	3.1
Lancaster	6.0	4.0	1.5
McKeesport	6.0	1.1	5.5
Meadville	5.0	1.0	5.0
New Bethlehem	1.28	.15	8.5
Philadelphia	373.0	88.85	4.2
Phœnixville	2.52	0.5	5.0
Pittsburgh	120.0	30.0	4.0
Pittston	2.5	1.1	2.3
Plymouth	9.3	0.6	15.5
Pottsville	450.0	1.5	300.0
Reading	154.2	4.0	38.5
Sayre	3.0	0.4	7.5
Scranton	80.0	5.0	16.0
Shamokin	41.0	1.0	41.0
Sunbury	4.7	0.4	11.8
Wilkesbarre	3.25	48.0	14.8
York	0.6	11.0	18.3
DELAWARE			
Newcastle	1.25	.45	2.8
Wilmington	41.6	5.3	7.8
MARYLAND			
Baltimore	983.0	34.0	29.2
Hagerstown	20.0	0.5	40.0
Union Bridge	.425	.04	10.6
Westminster	1.0	.01	100.0

The reservoir capacity in days' supply, given in the last column, shows naturally a very wide range from less than a day's to a year's supply. A large part of this variation is perfectly natural and proper, since it depends on the abundance of the supply relatively to the demand. The supply of a great city from a small river, as at New

York, naturally demands great storage capacity, which is soon to be made much greater. The reverse conditions naturally require but little reservoir capacity. The total storage capacity of most of the larger systems is given in Table 17-B.

The large reservoir capacities of the New York works as a whole, as compared with Pennsylvania, is notable. Nearly all the Pennsylvania works have but a few days' supply; most of the New York works, many days' supply.

DAMS.

The highest and most important water-works dam in the Middle States, and so far as we now know east of the Rocky Mountains, is the Druid Lake dam, of the Baltimore water-works. This dam is of earth, 119 ft. high, with a puddle heart-wall, 36 ft. thick at the bottom, extending down to rock 12 ft. below the surface. On the bed-rock a small rubble wall, 5 ft. high by 2 to 4 ft. wide is built to check percolation. The dam is a long one and has been an entire success. As the details are given quite fully in our account of the Baltimore works, we will not rehearse them now.

In all we have details of the following earth dams, omitting some of trifling importance:

New York, 28 earth dams, ranging in height from 12 to 60 ft., the majority of them above 35 ft. and built in most cases, unlike the New England dams, with puddle heart-walls. In New England, masonry heart-walls are almost universal; but we have no record of the failure of any of the New York puddle dams. The usual inside slopes are 2 to 2½ to 1, and outside, 1½ to 2 to 1. They are mostly quite short; under 500 ft.

New Jersey, 3 earth dams, the largest at Orange, 40 ft. high by 875 ft. long on top.

Pennsylvania, 15 dams (including 1 small rock-fill dam, backed with clay) the largest being that at Pottsville, 35 ft. high by 1,350 ft. long, 40 ft. wide on top, with 2 to 1 and 2½ to 1 slopes.

Maryland, (none in Delaware) the great Druid Lake dam above described and one other at Hagerstown.

The most important stone dam as yet existing is the Boyd's Corners dam of the Croton works, 78 ft. high. The main Croton dam (the first one of which was carried out under interesting circumstances which we will not repeat) is 40 ft. high. We have records of only 5 other masonry dams in New York, the highest 25 ft. high.

In New Jersey the only stone water-works dam is that at New Brunswick, 15 ft. high by 184 ft. long, which was built in 1743, strengthened about 1780, and stood intact until Feb. 25, 1888, or for over a century, when it gave way by "inherent weakness"; a weakness, we may add, which was singularly long in developing. The new structure was illustrated in ENGINEERING NEWS, June 16, 23, 1888. This dam is probably the oldest water-works dam on the continent, antedating by 11 years even the Bethlehem, Pa., works (1754) which are the second oldest on the continent and the oldest which can be said to have had a continuous existence. We believe, however, the Brunswick dam was not originally built for water supply purposes.

In Pennsylvania we have only 5 masonry dams reported, the largest being that at Scranton, 35 ft. high by 320 ft. long. The Fairmount dam at Philadelphia is a crib dam 30 ft. high and 1,112 ft. long, the old one built in 1819 having been renewed on substantially the same plan in 1872.

In Maryland there is a 40 ft. masonry dam about 500 ft. long, on the Baltimore works, and another 34 ft. dam; while the Potomac dam for the Washington water-works, 2,877 ft. long by a maximum of 20 ft. high, closes the list, being the largest cut stone dam for water-works purposes (if not for any purpose) in the United States.

There are only a few scattering crib dams in the Middle States, besides that at Philadelphia. The type is not favored, although largely used for manufacturing purposes.

TUNNELS.

The water-works tunnels are not very numerous but decidedly important, including the new Croton tunnel, 30 miles long and a few feet; the Baltimore tunnel 7 miles long (36,500 ft.); the Washington tunnel, 4 miles long (20,716 ft.); a tunnel of 870 ft. at Albany, 356 ft. at Troy; and probably 3 or 4 others of short length through rock, besides a subaqueous tunnel of 1,020 ft. at Buffalo. Erie takes water from Lake Erie through a 48-in. pipe 1,000 ft. long, laid in a crib extending out to take water from a point 13 ft. below the surface. Dunkirk takes water directly from the shore.

The stand-pipes of the Middle States will be summarized later with those for all the rest of the United States. We have records of a great many more than appeared in Mr. STEPHENS' paper, published in ENGINEERING NEWS of Oct. 6, and 13, 1888.

LARGE TOWNS STILL UNSUPPLIED WITH WATER-WORKS.

We find by comparison with the census records of 1880 that in spite of the fact that nearly half the works are in towns of less than 3,000 population, there are in each State the following towns of 4,000 population, or over, which have no water-works or (possibly) which have water-works which have escaped our notice. If the latter should be the case in respect to any of them, we shall be obliged for information to that effect.

Owing to a blunder in the census records, the list is in part deceptive as to the New England States, and gives an unfair comparison of them with the Middle States. In the latter only those towns were included as places of 4,000 inhabitants or over which had a town population proper of that size, within village or borough limits; as is plainly proper to do. In the corresponding census list for the New England States all (or most of) those which had a total population in the "township", of perhaps 6 miles square, of 4,000 or over were included as "towns" of that size.

In the following list for the New England States, only Ellsworth, Me., has the actual town or city population correctly given. The rest are all of them township populations, and should be reduced by 2,000 to 3,000 to get at the real town or village population. Thus, Stratford, Conn., the only town on the list for which we can give both populations, has a township population of 4,251, but a borough population of only 2,540. Still, with this reservation, the following list represents fairly well the large towns which still remain without water-works, several of which will be seen to have works already in progress, for only those are noted as "proposed" which were regarded by us, in compiling our record, as substantially arranged for:

New England Towns of 4,000 *Inhabitants or over without water-works,*

[All the subjoined are townships, including perhaps 1,000 to 2,500 of country population, except Ellsworth, Me., which is a city.]

MAINE.	Pop'n.	
Cape Elizabeth	5,302	
Eastport	4,006	(proposed)
Ellsworth	5,052	(proposed)
NEW HAMPSHIRE AND VERMONT, *none.*		
MASSACHUSETTS.	Pop'n.	
Andover	5,169	
Barnstable	4,242	
Blackstone	4,907	
Millbury	4,741	
Montague	4,875	
Needham	5,252	(proposed)
Northbridge	4,053	
North Brookfield	4,459	
Province town	4,346	
Salisbury	4,079	
RHODE ISLAND,	Pop'n	
Burrellville	5,714	(proposed)
Coventry	5,714	(proposed)
Cumberland	6,445	
Lincoln	13,765	
South Kingston	5,114	
Warwick	12,164	(proposed)
CONNECTICUT.	Pop'n.	
Enfield	6,755	
Groton	5,128	
Manchester	9,462	
Newtown	4,013	(proposed)
Portland	4,157	(proposed)
Stratford	4,251	
Thompson	5,051	
Vernon	6,915	

Middle States Towns and Cities of 4,000 *inhabitants and over without Water-Works.*

[Including only town or cities proper, with no country population included.]

	Population.
Edgewater, N. Y	8,044
Geddes, N. Y	4,283
Harrison, N. J	6,898
Plainfield, N. J	8,125

[Pennsylvania and Maryland, *none.*]

In addition to the preceding, Elmira, N. Y., (20,541 population) was by the accident of a delayed report, not included in any of the tabulated Middle States statistics, although it will be found to be included in the summary of these summaries, giving the status of the water-works of the whole United States.

NEW CONSTRUCTION.

We have details of the following works as projected with fair prospects of early construction:

New York	8
New Jersey	2
Pennsylvania	6
Delaware	0
Maryland	3
Total Middle States	19
Against, reported for New England States,	25

This will be an addition of about 5 per cent. against 9 per cent in New England, all of which are likely to be completed in 1889. Some may fall through, but others, not now reported, will more than make up for them.

THE WATER-WORKS OF THE SOUTH ATLANTIC AND SOUTH CENTRAL STATES.

The South Atlantic and South Central groups of States include all the States south of the Ohio and Potomac and East of the Mississippi, and also Louisiana, which is divided by the Mississippi. For certain purposes, it might have been better to have included also the Southwestern group, with these two groups but on the whole it appeared preferable to give the Southwestern and Northwestern groups together, which we do later.

If, as may fairly be claimed, the abundance of water-works in a community is one of the surest tests of its progress toward a high civilization, the status of water-works in the Southern States makes a most gratifying addition to the many proofs of the rapid progress of that section toward equality with all other sections in material prosperity. Superficially considered, the records might seem to indicate that that section is far behind, as it still is in density of population

TABLE 1-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.			YEAR.	Water-Works Built.		
	So. Atl.	So. Cent.	Total.		So. Atl.	So. Cent.	Total.
Before 1800	1	....	1				
1800-10	....	....	....	1871	1	....	1
1811-20	....	....	....	1872	1	2	3
1821-30	3	1	4	1873	1	2	3
1831-40	3	6	9	1874	1	....	1
1841-50	1	1	2	1875	2	....	2
1851	....	....	....	1876	2	1	3
1852	....	....	....	1877	1	....	1
1853	....	....	....	1878	2	....	2
1854	1	....	1	1879	....	2	2
1855	....	....	....	1880	2	1	3
1856	1	....	1	1881	2	1	3
1857	....	....	....	1882	4	....	4
1858	2	....	2	1883	2	2	4
1859	....	....	....	1884	1	1	2
1860	....	1	1	1885	5	1	6
1861	....	....	....	1886	7	6	13
1862	....	....	....	1887	8	4	12
1863	....	....	....	1888	17	18	35
1864	....	1	1	Unknown.	2	1	3
1865	....	....	....				
1866	....	....	....	Total South'n	73	55	128
1867	....	1	1	Total New	Main.	Subs.	
1868	....	1	1	England.	254	32	286
1869	....	....	....	" Middle.	406	27	433
1870	....	1	1				
Carried f'd.	12	13	25				

Subsidiary water-works are those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems. There is but one in the Southern States, Belleville, Ky., included in with the main works.

and number of large towns; but in comparison to the number of towns of suffiient size to make water-works possible (the only fair basis of comparison), most of the Southern States are now fully abreast with others, while the rate of progress seems faster, if anything, than in any of the older States.

The astonishing rate at which water-works have been multiplying in recent years, even in the North Atlantic States, becomes still more conspicuous and astonishing in the South, the figures standing as shown below and more fully in Tables 1 and 2.

No. of water-works opened.	South Atlantic.	South Central.	Total Southern.	Total New Eng.	Total Middle.
Before 1850........ ...	8	8	16	12	30
Decade ending 1860.	4	1	5	16	34
" " 1870	0	4	4	32	33
" " 1880	13	8	21	76	118
7½ years " 1888	48	34	82	150	218
A total of	74	55	128	286	433
Per cent in last 7½ yrs.	65.6	61.9	64.0	52.4	50.2
" " 17½ "	83.6	75.3	80.3	79.0	77.4

The last two lines of this table shows that, to an extraordinary extent, the water-works interest of all the Atlantic States may be said to have been created as a great interest within the last 10 or 15 years; but it is still more true of the South, and of the last 7½ years. In the decade ending 1880, the South was rather behind the North even in per cent. of new water-works, making its per cent. for 17½ years about the same; in all the groups we may say in a general way 80 per cent. of the water-works have been built since 1870.

TABLE 2-C.D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Date given is that of completion of works.]

DATE	South Atlantic States.							South Central States.						Grand Total.
	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	Total.	Ala.	Miss.	La.	Tenn.	Ky.	Total.	
Before 1800	1	..	....	....	....	....	1	......	......	....	......	......	......	1
1800-10	..	..	....	....	....	....	..	......	......	....	......	......	......	....
1811-20	..	..	....	....	....	....	..	......	......	....	......	......	......	....
1821-30	1	..	1	....	1	....	3	1	......	....	......	......	1	4
1831-40	2	1	....	....	....	....	3	1	......	1	2	2	6	9
1841-50	1	..	....	....	....	....	1	......	......	....	......	1	1	2
1851-55	..	..	....	....	1	....	1	......	......	....	......	......	......	1
1856-60	3	..	....	....	....	....	3	......	......	....	......	1	1	4
1861-65	..	..	....	....	....	....	..	......	......	....	1	......	1	1
1866-70	..	..	....	....	....	....	..	......	1	....	......	2	3	3
1871-75	3	1	....	....	2	....	6	2	......	....	1	1	4	10
1876-80	2	..	2	1	1	1	7	......	......	....	1	3	4	11
1881-85	6		3	..	3	1	14	2	......	....	2	1	5	19
1886-88	8	5	5	3	4	9	34	13	3	2	6	5	29	63
Total	27	8	11	4	12	11	73	19	4	3	13	16	55	128

Included in the total of 1886-88 are the following water-works of unknown dates, nearly all of which are known to belong to this period: Virginia 1, South Carolina 1, Tennessee 1.

But to appreciate the full contrast in the rate of Southern progress, it is necessary to consider the aggregate of the works chronicled in our "Manual" as "projected with fair prospects of early construc-

TABLE 3-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS. MAIN DETAILS BY STATES.

Summarized according to Date of Original Construction, showing the Present Condition of Works started in each Decennial or Quinquennial Period.

[N. B. the figures opposite each date must not be taken as representing the conditions of the works at that date, but merely as the *present condition* of works then existing.]

DATE.	Present pop'n of water-works.	No. of Works. Total.	Present Finances.		Miles of mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
VIRGINIA.								
1799-50	87,014	5	$1,724,102	$138,474	98.10	10,606	597	69
1851-60	35,965	3	291,132	26,631	27.90	1,713	267	......
1861-70	....	......	....	....	....	......	......	......
1871-80	40,815	5	1,187,748	74,355	70.00	6,100	313	73
1881-85	20,330	6	460,000	29,700	45.75	3,146	236	......
1886-88	19,216	7	277,500	25,396	53.30	1,129	242	......
Unkno'n	543	1	5,000	500	3.00	80	10	......
Total	203,883	27	$3,945,482	$295,056	298.05	22,774	1,665	141
WEST VIRGINIA.								
1834-50	30,737	1	$750,000	$58,000	41.00	6,900	150	......
1851-60	....	......	....	....	....	......	......	......
1861-70	....	......	....	....	....	......	......	......
1871-80	6,335	1	85,000	3,500	6.50	650	52	......
1881-85	6,582	1	106,000	9,500	12.00	680	60	......
1886-88	12,037	5	341,500	33,390	36.50	1,726	238	2
Total	55,691	8	$1,282,500	$104,390	96.00	9,956	500	2
NORTH CAROLINA.								
1829-50	3,485	1	$4,500	$1,000	2.00	100	9	......
1851-60	....	......	....	....	....	......	......	......
1861-70	....	......	....	....	....	......	......	......
1871-80	1,890	2	39,500	1,200	7.80	95	32	80
1881-85	27,298	3	383,000	46,377	29.85	1,126	258	182
1886-88	20,323	5	665,000	131,340	55.90	1,046	322	14
Total	52,996	11	$1,092,000	$179,917	95.55	2,367	621	276
SOUTH CAROLINA.								
1880	49,984	1	$400,000	$91,500	18.00	900	300	20
1881-85	....	......	....	....	....	......	......	......
1886-88	12,176	2	160,000	20,000	16.35	320	74	......
Unknown	2,549	1	20,000	2,000	2.00	50	20	......
Total	64,709	4	$580,000	$113,500	36.35	1,270	394	20
GEORGIA.								
1828-50	21,891	1	$500,000	$28,843	30.00	1,728	248	......
1851-60	30,709	1	300,000	49,174	32.60	2,850	312	......
1861-70	....	......	....	....	....	......	......	......
1871-80	42,153	3	548,000	40,551	35.40	2,530	441	2,043
1881-85	28,971	3	501,000	84,580	44.50	2,065	338	296
1886-88	9,398	4	161,000	30,250	20.25	526	147	5
Total	133,122	12	$2,010,000	$233,398	162.75	9,699	1,486	2,344
FLORIDA.								
1880	7,650	1	$112,000	$16,521	8.50	707	100	287
1881-85	1,300	1	50,000	4,700	3.50	275	30	9
1886-88	16,718	9	713,000	71,100	46.45	1,286	453	10
Total	25,668	11	$875,000	$92,321	58.45	2,268	583	306

Alabama.

1825 50	34,109	2	$250,000	$37,100	31.00	1,400	190	1
1851-60	......	......	......	......	......	......	......	......
1861-70	......	......	......	......	......	......	......	......
1871-80	19,799	2	950,000	102,400	71.00	3,400	332	956
1881-85	1,824	2	115,000	12,500	12.00	400	86	12
1886-88	25,055	13	2,011,200	229,845	126.50	2,325	983	12
Total	80,787	19	$3,326,200	$381,845	240.50	7,525	1,591	981

Mississippi.

1867-70	3,995	1	$25,000	$1,500	3.00	200	22	4
1871-80	......	......	......	......	......	......	......	......
1881-85	......	......	......	......	......	......	......	......
1886-88	18,013	3	445,000	41,500	29.30	690	255	8
Total	22,008	4	$470,000	$43,000	32.30	890	277	12

Louisiana.

1833-40	216,090	1	$2,397,000	$256,600	72.00	4,400	1,191	8
1841-80	......	......	......	......	......	......	......	......
1881-85	......	......	......	......	......	......	......	......
1886 88	15,206	2	350,000	27,800	14.50	734	181	....
Total	231,296	3	$2,747,000	$284,400	86.50	5,134	1,372	8

Tennessee.

1832-50	46,750	2	$2,050,000	$88,573	48.50	4,506	344	16
1851-60	......	......	......	......	......	......	......	......
1861-70	12,892	1	600,000	21,000	37.50	2,850	150	20
1871-80	37,472	2	895,000	141,000	68.00	4,810	393	245
1881-85	15,070	2	300,000	29,912	27.00	1,376	252	3
1886-88	4,934	5	205,000	21,500	17.50	720	85	......
Unknown	1 045	1	30,000	5,000	4.00	300	16	......
Total	118,163	13	$4,080,000	$306,985	202.50	14,562	1,240	284

Kentucky.

1832-50	23,814	3	$71,500	$12,000	12.50	615	9	.....
1851-60	123,758	1	5,008,809	256,556	137.40	11,001	147	678
1861-70	34,814	2	500,000	42,500	38.00	3,280	1,229	28
1871-80	37,259	4	1,210,982	72,677	64.85	5,251	401	166
1881-85	(duplicate)	1	250,000	23,600	17.50	464	232	199
1886-88	12,390	5	469,250	48,975	44.00	1,580	373	9
Total	232,065	16	$7,510,521	$456,308	314.25	22,191	2,391	1,080

tion." Most of these works are now in actual process of construction in all the sections; and while some of them have been dropped, others not so listed have been since started, so that the record fairly indicates the number which are likely to be opened in or soon after the current year; as follows:

Water-Works Projected with Fair Prospects of Construction.

Virginia	7	Alabama	2
West Virginia	1	Mississippi	
North Carolina	4	Louisiana	
South Carolina	3	Tennessee	5
Georgia	7	Kentucky	5
Florida	1	Total So. Central	17
Total South Atlantic	23	Grand total, Southern States	40
		Total New England States	25
		" Middle States	19

This shows a probable increase of 31.5 per cent. in the South Atlantic States, and 30 9 per cent. in the South Central, or 31.2 per cent. in the two groups together, against only 9 per cent. in New England and 5 per cent. in the Middle States. The decades preceding and ollowing the war show almost no progress in any of the Southern

States, as was to be expected; but this slow rate only makes more conspicuous that since 1880. That the present status of water-works is in fact anything but backward, is evidenced in another way by the fact that in Wales, Scotland, and Ireland, with a population of nearly 10½ millions there are only some 87 water-works, as will appear from statistics to be given later, whereas the South, with a population of under 13 millions and a white population of not over 9 millions, has 128 works already, with 40 more under way. In England proper, with a population of nearly 25 millions and 44 per cent. of it in towns of over 20,000 people, there would appear to be, all told, only 407 water-works, or not so many as in the five Middle States, with less than 12 million population, and with a considerably smaller ratio of town population. The South is, therefore, already more than abreast with England and far ahead of the rest of Great Britain. Poor Ireland, for example, with 5,160,000 population, has the liberal supply of *four* water works, so far as all available records indicate,—a fact which speaks louder than words can do of the wretched condition of that unhappy island. There were not wanting predictions that when "the late unpleasantness" came to an end, the South was to become "an American Ireland." It needs no statistics to prove now that this has not been the case; how far it is from being so these records show.

TABLE 4.-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-C-D.

State.	Pop'n on Water-Works 1880 census.	No. of Works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue		Taps.	Hy-dr'ts	Me-ters.
Virginia	203,883	27	$3,945,482	$295,056	298.05	22,774	1,665	141
West Va	55,691	8	1,282,500	104,300	96.00	9,956	500	2
No. Carolina......	52,986	11	1,092,000	179,917	95.55	2,367	621	276
So. Carolina	64,709	4	580,000	113,500	36.35	1,270	394	20
Georgia	133,122	12	2,010,000	233,398	162.75	9,699	1,486	2,344
Florida........	25,668	11	875,000	92,321	58.45	2,268	583	306
Total So. Atlantic	536,069	73	$9,784,982	$1,018,582	747.15	48,334	5,249	3,089
Alabama..........	80,787	19	$3,326,200	$381,845	240.50	7,525	1,591	981
Mississippi	22,008	4	470,000	43,000	32.30	890	277	12
Louisiana..........	231,296	3	2,747,000	284,400	86.50	5,134	1,372	8
Tennessee	118,163	13	4,080,000	306,985	202.50	14,562	1,240	284
Kentucky....	232,035	16	7,510,521	456,308	314.25	22,191	2,391	1,060
Total So. Cent....	684,289	55	$18,133,721	$1,472,538	876.05	50,302	6,871	2,365
Total Southern ..	1,220,358	128	$27,918,703	$2,491,120	1,623.20	98,636	12,120	5,454
Total Middle	6,165,618	433	156,522,264	15,025,661	7,428.03	890,021	56,095	33,991
Total N. Eng....	2,409,359	287	84,992,72"	6,412,624	5,290.70	315,404	32,300	37,913

Tables 3, 4, and 5, showing by States the main statistics of water-works, call for no special remark except to notice that the South Central States, while having the smaller number of water-works (55 against 73) have nearly twice as large a capital, 45 per cent. more revenue, and a considerably larger mileage of mains and number o taps. The more interesting records are those contained in Tables 6, 7, and 8, showing deductions from the main statistics.

TABLE 5-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS, AS GIVEN IN TABLE 3.

DATE.	Present pop'n of water-works.	No. of Works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-drants.	Me-ters.
				SOUTH ATLANTIC STATES.				
1799-1850	143,127	8	$2,978,602	$226,317	171.10	19,334	1,004	69
1851-60	66,674	4	591,132	75,805	60.50	4,563	579	.....
1861-70	....	.....	....	....	....	....	....	.....
1871-80	148,827	13	2,372,248	227,627	146.20	10,982	1,238	2,502
1881-85	84,481	14	1,500,000	174,857	135.60	7,292	922	487
1886-88	89,868	52	2,318,000	311,476	228.75	6,033	1,476	31
Unkno'n	3,092	2	25,000	2,500	5.00	130	30	.....
T'l.S.Atl.	536,069	73	9,784,982	1,018,582	747.15	48,334	5,249	3,089
				SOUTH CENTRAL STATES.				
1825-50	320,763	8	4,768,500	394,273	164.00	10,921	1,734	25
1851-60	123,758	1	5,008,809	256,556	137.40	11,001	147	678
1861-70	51,701	4	1,125,000	65,000	78.50	6,330	1,401	52
1871-80	94,530	8	3,055,962	316,077	203.85	13,461	1,126	1,367
1881-85	16,894	5	665,000	66,012	56.50	2,240	570	214
1886-88	75,598	28	3,480,450	369,620	231.80	6,049	1,877	29
Unkno'n	1,045	1	30,000	5,000	4.00	300	16	......
T'l. S. C'l	684,289	55	18,133,721	1,472,538	876.05	50,302	6,871	2,365
				GRAND TOTALS, SOUTH ATLANTIC AND SOUTH CENTRAL STATES TOGETHER.				
1799-50	463,890	16	7,747,102	620,590	335.10	30,255	2,738	94
1851-60	190,432	5	5,599,941	332,361	197.90	15,564	726	678
1861-70	51,701	4	1,125,000	65,000	78.50	6,330	1,401	52
1871-80	243,357	21	5,428,210	543,704	350.05	24,443	2,364	3,869
1881-85	101,375	19	2,165,000	240,869	192.10	9,532	1,492	701
1886-88	165,466	60	5,798,450	681,096	460.55	12,082	3,353	60
Unkno'n	4,137	3	55,000	7,500	9.00	430	46	.....
Gr'd T'l.	1,220,358	128	27,918,703	2,491,120	1,623.20	98,636	12,120	5,454

N. B.—This table does *not* represent the status of the works at the several dates (except as to number) but the statistics for the *current year* 1888, of works *first opened* at the several dates.

The unfairness of using total population as a basis for comparing water-works statistics is strikingly brought out in Table 6. While the total population of the two groups of Southern States is nearly 13 million as against nearly 12 in the Middle States, the total *town* population (in towns or cities of 4,000 or over) is barely one-fifth as great, the per cent. of such town popualtion being only 9.8 per cent. in the South against 47.2 per cent. in the Middle States. It will be seen by the next to last column of Table 6 that the total population on water-works is 107.1 per cent. of the total *town* population in the Southern States against 113.1 per cent. in the Middle States and 120.6 per cent. in New England; a closely approximate ratio from any point of view; but when we consider the large colored population of the South, which pays hardly any taxes, and is not so progressive an element as the white laboring class, and when we consider further how short a time it still is since the war, and that the sources of supply are inferior, as we shall see, the showing is from every point of view a remarkably good one. Again, we find from our lists that there are in the whole South only 6 towns which had a population of 4,000 or over in 1880 which have not now water works, at 2 of which water-works are projected; or no more in proportion than in the New England and Middle States. In 6 States out of the 11 there are no such towns without water-works. The list is as follows:

TABLE 6-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over]

STATES.	Total Population.			Town Population 1880.	Per cent. of total.	Pop'n on Water-works, 1888.			Av. pop'n on each Water-works.
	1870	1880	Inc. per cent.			Tot'l 1880 by Census.	P. C. of Total pop'n.	P. C. of Town pop'n.	
GROUP C.—SOUTH ATLANTIC STATES.									
Virginia	1,225,163	1,512,565	23.4	178,117	11.8	203,883	13.5	114.4	7,570
W. Virginia	442,014	618,457	39.9	47,846	7.8	55,691	9.0	116.4	6,960
N. Carolina	1,071,361	1,399,750	30.6	40,152	2.9	52,996	3.8	132.0	4,820
S. Carolina	705,606	995,577	41.0	66,180	6.6	64,709	6.5	97.8	16,177
Georgia	1,184,109	1,542,180	30.2	118,980	7.7	133,122	8.6	111.9	11,100
Florida	187,748	269,493	43.5	24,385	9.1	25,668	9.6	105.3	2,330
Tot. S. Atlantic	4,816,001	6,338,022	31.6	475,660	7.5	536,069	8.5	112.7	7,330
GROUP D.—SOUTH CENTRAL STATES.									
Alabama	996,992	1,262,505	26.6	58,351	4.6	80,787	6.4	138.4	4,250
Mississippi	827,922	1,131,597	36.6	28,084	2.5	22,008	1.9	78.3	5,502
Louisiana	726,915	939,946	29.3	231,296	24.6	231,296	24.6	100.0	77,099
Tennessee	1,258,520	1,542,359	22.5	114,904	7.4	118,163	7.6	102.8	9,080
Kentucky	1,321,011	,648,690	24.8	231,720	14.1	232,035	14.1	101.4	14,440
Tot. S. Central	5,131,360	6,525,097	27.2	664,355	10.2	684,289	10.5	103.0	12,400
Tot. Southern	9,947,361	12,863,119	58.8	1,140,015	8.9	1,220,358	9.5	107.1	9,530
do. Middle	9,848,413	11,756,053	19.4	5,538,729	47.2	6,165,618	52.5	113.1	14,220
do. New England	3,487,924	4,010,529	15.0	1,989,339	49.6	2,409,359	59.8	120.6	8,391

The apparent large increase of population in the Southern States is to a great extent deceptive, owing to errors of omission in the census of 1870.

Towns without water-works	*Population.*	
New Berne, N. C.	6,443	
Greenville, S.C.	6,160	
Key West, Fla.	9,896	(projected, but now indefinite)
Jackson, Miss.	7,204	
Natchez, Miss.	5,058	(projected)
Hopkinsville, Ky.	4,229	

Table 7 shows likewise very creditable progress in the South. The percentage of the total number of water-works in towns of various sizes is:

	Southern.	Middle.	N. Eng.
Towns of 1,000 or under.	17.2	10.9	13.9
" " 3,000 " "	49.1	51.0	41.8
" " 5,000 " "	60.6	69.0	64.3
" "10,000 " "	78.6	87.0	81.2

The percentage of small towns supplied isgreater in the South than in either of the other sections.

TABLE 7-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

States.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over	Total No.
Virginia....	6	7	2	4	3	3	25*
West Va.......	1	2	2	2	....	1	8
No. Carolina ...	1	5	2	2	1	....	11
So. Carolina	....	2	....	....	1	1	4
Georgia.........	1	4	1	1	2	3	12
Florida..........	4	5	....	2	....	....	11
Total So. Atl.	13	25	7	11	7	8	71
Alabama.......	4	7	3	1	1	1	17*
Mississippi......	....	1	2	....	1	....	4
Louisiana......	....	....	....	2	....	1	3
Tennessee.......	2	4	2	2	1	2	13
Kentucky	2	2	....	6	1	3	14*
Total So. Cent..	8	14	7	11	4	7	51
Grand Total....	21	39	14	22	11	15	122
do Middle...	47	174	78	78	24	32	433
do New Eng.	40	80	65	48	35	19	287

*2 duplicate systems in Virginia, 2 in Alabama, and 2 in Kentucky, reduce the totals by so much.

The statistics of Table 8 are of special interest as indicating the comparative status of water-works. The investment per head on water-works will be seen to be $18.25 in the South Atlantic group and $26.50 in the South Central ($22.80, average of entire South) as against $25.40 in the Middle States and $35.30 in New England; certainly a most creditable showing, in connection with the fact that there is as large a proportion of the town population supplied with water-works in the South as elsewhere. The cost per mile of main ($17,180) is higher than in New England but lower than in the Middle States, largely owing to the presence of a few very costly water-works in the latter. The cost per tap is higher in the South than in either section.

The revenue per head ($2 04) is lower, and the revenue per tap ($25.30) higher than elsewhere, indicating clearly that there is a smaller proportion of the population potentially supplied which uses the water, as is but natural. The revenue per mile of main ($1,533) is but little larger than in New England, and far below the Middle States, indicating that there is no waiting for great inducements before building works. The population per tap (12 4) is very large, owing to the cause just noted, that many who might do not use the water. The population per meter is also large, 224 against 181 in the Middle States and 63 in New England.

The per cent. of revenue to cost is 8.93 against 9.40 per cent. in the Middle States and 7.54 in New England. In the South Central

TABLE 8-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

STATE	Cost per			Revenue per			Population on water-works.		P. C. rev. to cost.
	head on water-works.	mile of main.	tap.	head on w'ter w'ks.	mile of main	tap.	per tap.	per meter	
Virginia	$19.37	$13,550	$173	$1.45	$983	$13.00	9.1	1,445	7.48
W. Virginia	23.05	13,370	129	1.88	1,085	10.50	5.6	....	8.13
No. Carolina	20.60	11,4 0	4 0	3.21	1,880	76.00	22.4	192	10.65
So. Carolina	8.97	15,950	456	1.75	3.125	89.00	50.9	....	19.58
Georgia	15.12	12,310	207	1.75	1,430	24.00	11.7	58	11.60
Florida	34.10	14,960	3 6	3.59	1,575	40.60	11.3	85	10.53
Av. So. Atlantic	$18.25	$13,670	$202	$1.90	$1,362	$21.00	11.1	173	10.40
Alabama	$41.15	$13,810	$44	$4.73	$1,584	$50.80	10.7	82	11.48
Mississippi	21.40	14,540	529	1.95	1,340	48.30	24.7	....	9.16
Louisiana	11.87	31,780	536	1.23	3,285	55.50	45.1	....	10.38
Tennessee	31.50	20,180	280	2.60	1,518	21.10	8.1	417	7.54
Kentucky	32.30	24,900	338	1.96	1,452	20.60	10.5	215	6.04
Av. So. Central	$26.50	$20,650	$360	$2.15	$1,678	$29.20	13.4	289	8.13
Av. Southern	$22.80	$17,180	$283	$2.04	$1,533	$25.30	12.4	224	8.93
do. Middle	25.40	21,000	176	2.43	2,023	16.90	6.9	181	9.40
do. New Eng.	35.30	16,080	269	2.66	1,213	20.30	7.6	63	7.54

TABLE 9-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—KIND OF WORKS.

STATE	Gravity	Pumping to				Unkno'n	Total	P. C. gravity works.
		Reservoir.	Tank.	Stand-Pipe	Direct.			
Virginia	8	10	4	2	1	2	27	29.6
W. Virginia	....	3	2	....	3	....	8	....
No. Carolina	3	3	3	3	....	....	12	25.0
So. Carolina	....	1	1	2	....	....	4	....
Georgia	1	1	4	3	3	....	12	8.3
Florida	....	....	5	3	3	....	11	....
Total So. Atl.	12	18	19	13	10	2	74	16.2
Alabama	1	5	2	9	....	2	19	5.3
Mississippi	....	2	....	1	1	....	4	....
Louisiana	....	1	....	3	....	....	4	....
Tennessee	1	3	2	5	1	1	13	7.7
Kentucky	3	6	1	3	....	....	16	19.7
Total So. Cent.	5	17	5	21	5	3	56	8.9
Total Southern	17	35	24	34	15	5	130	13.1
do. Middle	175	116	33	44	40	4	412	42.4
do. New Eng.		50	21	31	21	5	258	50.4

As some of the works have a double system, the total exceeds by 2 that of Table 4-C-D. Several gravity works have small auxiliary pumping systems for special service which have been disregarded. Most of the pumping works pump direct in case of fire.

group, however, which seems to the most progressive, it is only 8.13, and in Kentucky and Tennessee under 7 per cent.

The greater difficulty of obtaining good sources of supply is indicated in Table 9, which shows by the small percentage of gravity works that the facilities for good water supply are inferior. In 5 of the 11 States there are no gravity works, and in 3 others only one each; the two most northerly States, with a little corner of North Carolina, containing practically all the gravity works, which are only 17, or 13.1 per cent. against 42.4 per cent. in the Middle States and 50.4 per cent. in New England. The contrast is owing to natural causes, which are well understood, and which we need not go into. The further north we go on this continent, the more lakes there are; and in the South, which is wholly of a sedimentary formation, and has never been subjected to ice action, lakes are rarely or never met with.

It will be seen that tanks and stand-pipes are chiefly used for pumping works in the South, and reservoirs comparatively little. We reserve further discussion of this point, however, until we review the United States as a whole.

TABLE 10-S-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—SOURCES OF SUPPLY.

STATE.	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Virginia	1	12	1	6	2	2	1	2	27
West Virginia..	....	1	....	7	....	....	....	....	8
North Carolina.	1	3	....	3	....	2	3	....	12
South Carolina.	....	....	....	1	....	....	3	....	4
Georgia	....	2	2	1	....	1	6	....	12
Florida	....	....	....	....	4	1	6	....	11
Total So. Atl....	2	18	3	18	6	6	19	2	74
Alabama........	....	5	2	3	....	4	4	1	19
Mississippi.	1	....	....	1	....	....	2	....	4
Louisiana.	....	....	....	2	....	....	....	1	3
Tennessee.	....	4	....	5	....	....	3	1	13
Kentucky	1	3	1	9	....	1	....	....	15
Total So. Cent..	2	12	3	20	....	5	9	3	54
Total Southern	4	30	6	38	6	11	28	5	128
Per cent	93.1	23.4	4.7	29.7	4.7	8.6	21.9	3.9	100.0
" Middle .	8.3	25.1	10.7	21.6	4.4	14.8	14.1	1.0	100.0
" New Eng	14.0	17.4	16.3	14.0	27.1*	....	7.7	3.5	100.0

* Including 14.7 per cent. of so called "ponds" really, lakes.

The table of sources of supply (Table 10) shows another striking contrast between the Southern and Northern water-works. "Surface," "brook," and "lake" supply are almost wholly eschewed in the South, for a very good reason. Wells are far more used than in the North Atlantic States, and rivers supply a much larger proportion here than elsewhere. Springs also are largely relied on, but chiefly by pumping from them.

Tables 11 and 12 show the pressures used, which average 62 to 66 lbs., or 5 to 10 lbs. lower than in the North Atlantic States. Abou half the works reporting use higher fire pressures, the favorite fire pressure being 90 to 100 lbs., and the common increase above working pressures 30 to 70 lbs. There are several works, however, with very high pressures of nearly 200 lbs.

TABLE 11-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS—AVERAGE WORKING PRESSURES.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence, considerably higher than the effective pressure.]

PRESSURE per sq. in.	Va.	W Va.	N. C.	S.C.	Ga.	Fla.	Tot'l S.Atl.	Al.	M.	La.	Ten.	Ky.	Tot'l So. C.	Gr'd Tot'l
Under 20	....	....	1	....	1	......	2	....	....	....	......	...	......	2
20–29	2	....	......	....	...	......	2	...	1	1	......	...	2	4
30–39	2	....	1	...	2	1	6	1	..	....	2	2	5	11
40–49	2	3	3	3	3	1	15	3	....	....	1	2	6	21
50–59	1	...	1	....	1	2	5	3	....	....	3	2	8	13
60–69	3	1	1	...	....	2	7	1	1	....	1	1	4	11
70–79	....	....	2	....	3	2	7	2	....	....	1	2	5	12
80–89	1	2	2	....	1	......	6	2	....	1	1	1	5	11
90–99	1	....	....	....	....	......	1	1	....	....	1	....	2	3
100–109	2	1	......	...	....	......	3	...	....	....	......	....	......	3
110–119	1	...	......	....	...	......	1	1	....	....	......	....	1	2
120–129	1	....	......	...	...	......	1	....	....	....	......	1	1	2
130–139	....	...	......	....	....	......	......	....	....	....	......	....	......	......
140–149	....	....	......	....	....	.....	......	....	....	....	......	...	.....	......
150–159	....	....	......	....	....	......	......	....	...	....	......	1	1	1
160–169	....	....	......	....	....	......	......	...	...	....	......	....	......	......
170–179	....	...	......	....	...	......	......	....	....	....	......	...	....	......
Total works reporting.	16	7	11	3	11	8	56	14	2	2	10	12	40	96
	Average Pressure, lbs.......						62.0	Average Pressure, lbs.......						66.2
	" New England......						72.5	" Middle States.....						68.3

The ownership of the works, as shown in Table 13, is another interesting point. In this also the South compares extremely well with other sections, if the percentage of works built by the public be taken as a criterion. The comparison stands as follows:

	South Atlantic.	South Central.	Total Southern.	Total Middle.	Total New England.
Per cent. of public works, by no.	56.3	23.6	42.2	33.5	41.4
" pop'n supl'd on pub. wks.	64.4	21.5	39.5	78.3	72.3
Population per private works	6,000	13,080	9,840	4,930	3,980

The unfavorable contrast in the last two lines is due almost wholly to the single city of New Orleans (216,090, population) which happens to be supplied by private water-works (the largest city in the U. S., so supplied except San Francisco) Louisville also (123,758, population) has been classed as supplied by private works, perhaps improperly, as the city has from the first owned a majority of the stock. Such public control of a private company seems to offer a very sensible way for cities to take hold of water-works, as it gives most of the advantages of city and private ownership combined. These two cities include 51.2 per cent. of the water-works population of the Central group, and 30 per cent. of both groups together. Had they been included with the public works (and New Orleans also has aided its water-works), the total population supplied by public works would have been 70 per cent. in the South or substantially the same as in the North Atlantic group. Virginia, West Virginia and Georgia stand very high in this respect, and most of the South Central group rather ow, as will be found to be the case in the West generally.

Meters are not much used in the South, yet Table 14 shows that the banner town of the whole country in this respect is there,—Atlanta, Ga., with 2,000 taps, all metered. Montgomery, Ala., and Lexington, Ky., have also a large number, but there are only 8 works in the whole South with so many as one-sixth of their taps metered, and there are only 5,453 meters in the South in all, against 34,046 in the Middle States and 37,813 in New England. Our Atlanta report specifies that the meters have "proved a great saving to the city, reducing the pumpage and increasing the pressure. Unfortunately the consumers choose their own meter, often putting in a size smaller than the service-pipe, thus running the meter to death."

TABLE 12-C-D.

FIRE PRESSURE OF SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE lbs. per sq. in.	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	To'al So. Atl.	Al.	M.	La.	T'n	Ky.	Tt'l S.C.	Grand Total.
30-39	....	....	....	....	....	....	....	....	....	....	....	....	....	....
40-49	....	....	....	....	....	....	....	....	....	....	....	....	....	....
50-59	....	....	....	....	....	....	....	....	....	....	....	1	1	1
60-69	1	....	....	....	....	....	1	....	....	....	....	....	....	1
70-79	....	....	1	....	....	....	1	....	....	....	....	1	1	2
80-89	....	2	....	....	....	....	2	....	....	....	....	....	....	2
90-99	1	1	....	....	1	....	3	3	1	....	....	....	4	7
100-109	1	....	3	....	1	2	7	2	....	....	2	1	5	12
110-119	....	....	....	....	1	1	2	1	....	....	1	....	2	4
120-129	2	....	1	....	1	....	4	....	....	....	....	1	1	5
130-139	..	....	....	....	....	....	....	....	....	....	....	..	....	....
140-149	2	....	....	....	....	....	2	....	....	....	....	....	....	2
150-159	....	....	....	....	....	....	....	1	....	....	....	....	1	1
160-169	....	....	....	....	....	1	1	....	....	....	....	....	....	1
170-179	....	....	....	....	....	1	1	....	....	1	1	1*	3	4
Total works reporting.	7	3	5	0	4	5	24	7	1	1	4	5	18	42

*200 lbs.

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

	Va.	W. Va.	No. Ca.	So. Ca.	Ga.	Fla.	To'al So. Atl.	Al.	M.	La.	T'n	Ky.	Tt'l S.C.	Grand Total.
10 lbs. or under.	....	....	....	....	....	....	....	1	....	....	....	....	1	1
10-19	....	....	....	....	....	....	....	....	....	....	....	1	1	1
20-29	....	1	....	....	1	1	3	....	....	....	1	....	1	4
30-39	1	....	2	....	1	....	4	....	1	....	....	1	2	6
40-49	1	1	1	....	....	....	3	3	....	..	....	....	3	6
50-59	....	1	2	....	....	....	3	1	....	....	2	...	3	6
60-69	3	....	....	....	....	2	5	1	....	....	....	1	2	7
70-79	....	....	....	....	....	....	....	1	....	....	....	1	2	2
80-89	2	....	....	....	2	....	4	....	....	....	....	....	....	4
90-99	....	....	....	....	....	....	....	....	....	1	....	....	1	1
100-109	....	....	....	....	....	1	1	....	....	....	1	....	1	2
110-119	....	....	....	....	....	....	....	....	....	....	....	....	....	....
120-129	....	....	....	....	....	1	1	....	....	....	....	1*	1	2
Total works reporting.	7	3	5	0	4	5	24	7	1	1	4	5	18	42

*149 lbs.

Hydrant rentals, as shown in Table 15, run high in the South. The average is fully $50, against perhaps $30 in New England and $40 in the Middle States. The higher price has no doubt come about as an inducement for the construction of works, the absolute money able size. The most interesting reservoir is that at Knoxville, Tenn., whose sudden catastrophe was described in our Vol. XI, pp. 92, 93. There is a tunnel of 200 ft. at Memphis, another of 684 ft. at Covington, Ky., and two others of 400 and 2 300 ft. under way at Birmingham, Ala., which seems on the road to become a great city. As a whole, the water-works of the South are highly creditable to it.

TABLE 16-C-D.

SOUTH ATLANTIC AND SOUTH CENTRAL STATES WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically).	No. of Pumps.			Capacity, millions of gallons.				
	South Atlantic.	South Central.	Total.	South Atl'n'c	South Centr'l	Total South.	Total Middle	T'tal N. E.
Blake	5	17	22	4.2	34.2	38.4	26.1	21.4
Cameron	......	......	......	......	......	......	1.6	......
Corliss	......	......	......	......	......	......	22.0	20.0
Cornish	......	......	......	......	......	......	19.3	9.0
Davidson	......	2	2	......	5.0	5.0	28.7	12.5
Deane	12	14	26	13.6	29.6	43.2	19.4	39.5
Galloway	......	......	......	......	......	......	6.0	......
Gordon & Maxwell	7	5	12	5.1	7.5	12.6	8.5	......
Holly-Gaskill	11	20	31	21.0	60.0	81.0	156.9	17.5
Knowles	7	5	12	8.9	9.1	18.0	32.1	19.5
Lang	......	......	......	......	......	......	8.2	6.5
Lowery	......	......	......	......	......	......	10.0	......
Smith & Vaile	4	......	4	4.0	......	4.0	......	
Volker & Felthousen	......	......	......	......	......	......	5.5	......
Wetherill	......	......	......	......	......	......	12.0	......
Wood	1	......	1	5.0	......	5.0	6.0	9.5
Worthen	......	......	......	......	......	......	5.5	......
Worthington	25	11	36	39.9	47.5	87.4	344.6	123.8
Wilson & Snyder	1	......	1	1.0	......	1.0	6.6	......
Miscellaneous	12	16	28	37.3	33.2	70.5	262.2	62.9
Totals	85	90	175	140.0	226.1	366.1	981.2	342.1

THE WATER-WORKS OF THE NORTH CENTRAL STATES.

Included in the North Central States are the five States of Ohio, Indiana, Michigan, Illinois, and Wisconsin. While these five States offer a close general similarity of conditions, the following tables show likewise some striking differences. The tables are given the same numbers as the corresponding tables of our previous reviews,* distinguishing them by adding to the number the letter *E*.

To an even greater extent than in the preceding group of States, as is natural, the water-works interest of this group is a very recent creation. Before 1851, only 7 waterworks existed in the whole group. In the next decade, 1851-61, only 3 others were added. In the war years, 1861-66, only 1 work was added in the whole region, and that a very insignificant one at Salem, O., with a pump of 6 × 12 ins. In the three succeeding years, to 1869, only 2 others were added, so that at that date there were only 13 water-works in this whole group.

Then began the rapid progress. In the next two years, 1869-70, the number of works was more than doubled by the addition of 14 works. In the next decade, 1871-80, 80 were added; in the next half-decade, 1881-85, 87 more; while in the past 2½ years there has been added the great total of 135, including 2 unknown, which prob ably belong to this period. Comparing with other sections, we have:

Number Water-Works opened.		No. Cent.	Southern.	Middle.	New Eng.
Before	1851	7	13	30	12
Decade ending	1860	8	5	34	16
" "	1870	17	4	33	32
" "	1880	80	21	118	76
7½ years "	1888	222	82	218	150
A total of		329	128	433	286
Per cent. in last 7½ years		67.5	64.0	50.2	52.4
" " " 17½ "		91.9	80.3	77.4	79.0

The details of this record are shown more fully in Tables 1-E and 2-E. The last two lines above are significant, especially in the close equality ratio in of increase between the South and the North Central States, and in the small difference in rate of recent progress in all the sections. The figures show clearly that the South is now marching to the same tune of progress as the rest of the Union, because, although the number of works there seems small, yet, as will be seen

TABLE 1-E.

NORTH CENTRAL STATES WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.					
	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.
Before 1800	....	....	....	....	....	....
1800-10	....	....	....	....	....	....
1811-20	1	....	....	....	....	1
1821-30	...	...	1	...	....	1
1831-40	1	....	1	1	....	3
1841-50	1	1	....	...	....	2
1851	....	....	....	....	....	....
1852	....	....	....	....	....	....
1853	....	....	....	....	....	....
1854	....	....	....	....	....	....
1855	....	....	....	....	....	....
1856	1	....	....	....	....	1
1857	....	....	....	....	....	....
1858	....	....	....	....	....	....
1859	....	....	....	....	....	....
1860	....	1	....	1	....	2
1861	....	..	....	...	....	....
1862	1	....	...	....	....	1
1863	....	....	...	....	....	...
1864	....	....	....	....	....	....
1865	....	....	....	....	....	....
1866	....	....	....	1	....	1
1867	....	....	....	....	....	....
1868	....	....	....	1	....	1
1869	2	1	1	1	....	5
1870	4	2	3	....	....	9
Carried f'd	11	5	6	5	0	27

YEAR.	Water-Works Built.					
	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.
Br't forward.	11	5	6	5	0	27
1871	1	1	2	1	....	5
1872	4	....	3	1	....	8
1873	3	5	1	3	1	13
1874	2	1	...	6	....	9
1875	1	3	2	3	...	9
1876	1	2	1	6	1	11
1877	......	1	1	1	1	4
1878	(1) 1	....	2	1	...	(1) 4
1879	3	2	3	1	1	10
1880	1	1	3	1	....	6
1881	2	1	2	2	....	7
1882	6	...	8	(1) 6	2	(1) 22
1883	3	....	8	3	1	15
1884	5	1	6	5	1	18
1885	2	2	5	6	9	24
1886	(1) 5	9	9	9	3	(1) 35
1887	(1) 6	2	6	9	9	(1) 32
1888	12	7	15	19	11	64
Unknown.	1	....	1	......	....	2
T'tal No.Cent.	(3) 70	43	84	(1) 88	40	(4) 325

	Main.	Subs.	Total
T'tal No.Cent.	325	4	329
" N. Eng.	254	32	286
" Middle	406	27	433
" So. Atl.	73	0	73
" So. Cent.	54	1	55

Subsidiary water-works, viz., those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems are enumerated above in (parentheses). There are but 4 in the North Central States.

from Table 6-E, the ratio of water-works to city population is about the same as in other sections. This appears still more clearly from the following.

TABLE 2-E.

NORTH CENTRAL STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Date given is that of completion of works.]

DATE.	Ohio.	Ind.	Mich.	Ill.	Wis.	Totals.	Grand Total.
1811-20	1	....	....	....	....	1	1
1821-30	....	....	1	....	....	1	1
1831-40	1	....	1	1	....	3	3
1841-50	1	1	....	....	....	2	2
1851-55	....	....	....	....	....	....	....
1856-60	1	1	....	1	....	3	3
1861-65	1	....	....	....	....	1	1
1866-70	6	3	4	3	....	16	16
1871-75	11	10	8	14	1	44	44
1876-80	(1) 6	6	10	10	3	(1) 35	36
1881-85	18	4	29	(1) 22	13	(1) 86	87
1886-88	(2) 23	18	30	37	23	(2) 131	133
Unknown.	1	....	1	....	....	2	2
Total.	(3) 70	43	84	(1) 88	40	(4) 325	329

The number of water-works recorded as now proposed, with fair prospects of construction, is much smaller than in the South, or even in New England. There are now proposed:

In Ohio	4			
" Indiana	4			
" Michigan	2			
" Illinois	7			
" Wisconsin	4			
Total North Central group	21	against	329	existing.
" Southern "	40	"	128	"
" New England "	25	"	286	"
" Middle "	19	"	433	"

This shows a percentage of only 6.4 against 31.2 per cent in the South, 9 per cent. in New England, and 5 per cent. in the Middle States. It is probable, or we may even say quite certain, that in each group the actual additions of 1889 will largely exceed these aggregates, but the contrast from any point of view shows how the South is catching up.

The first water-works in each of the States was: *Ohio*, Cincinnati, 1820, with no second till 1835, and no other large works till Cleveland, 1856. *Indiana*, Madison, 1849, with no large works till Indianapolis, 1870. *Michigan*, Detroit, 1827 (the oldest in the Northwest), with Grand Rapids, 1849, and Kalamazoo and Jackson, 1869-70. *Illinois*, Chicago, 1840, with no other till 1860; Springfield, 1866, and Peoria, 1868. *Wisconsin*, none till Milwaukee, 1873, with only 7 others before 1885. All these are dates of opening the works. Some were probably under construction, and perhaps partially in use, a year or two before.

Table 4-E shows that this North Central group may be more evenly compared with New England than with any other group. With considerably larger population, there is nearly the same (a little less) mileage of mains, only about 80 per cent. as much capital invested, about 5 per cent. more revenue, and nearly 15 per cent. more works. The number of taps is also about 15 per cent. greater.

TABLE 3-E.

North Central States water-works. Main details by States.

Summarized according to Date of Original Construction, showing the Present Condition of Works OPENED *in each Decennial or Quinquennial Period.*

[N. B. The figures opposite each date must not be taken as representing the conditions of the works at that date, but merely as the *present condition* of works then existing.]

Date.	Present pop'n of water-works.	No. of Works. Total.	Present Finances.		Miles of mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
			Ohio.					
1820-50	285,365	3	$8,765,368	$705,023	319.00	36,072	2.997	1,283
1851-60	160,146	1	5,053,091	394.154	252.00	22.658	2,617	1,525
1861-70	121.812	7	2,822,134	176.164	169.00	9,681	1,277	584
1871-80	158,792	(1) 17	3,558,000	307,657	246.30	12.735	1,852	511
1881-85	116.418	18	2,426,851	215,317	227.53	9,323	1,748	202
1886-88	96,566	(2) 23	3,151,500	229,817	280.63	5,473	2,023	74
Unknown.	1,216	1	10,000	2,000	3.00	100	20	....
Total	940,315	(3) 70	$25,786,944	$2,030,032	1,447.46	96,042	12,434	4,179
			Indiana.					
1849-50	8,945	1	$250,000	$7,000	12.00	700	240	.....
1851-60	2,730	1	60,000	15,500	7.00	300	75	......
1861-70	84.479	3	692,000	118,729	104.00	2,499	809	150
1871-80	169,843	16	2,584.400	214,232	226.20	11 250	1,982	273
1881-85	23,975	4	481,000	41,415	42.00	1,583	433	10
1886-88	77,358	18	1,589.800	132,380	136.95	4.510	1,207	63
Total	367,330	43	$5,657,200	$529,256	528.15	20,842	4,746	496
			Michigan.					
1827-50	148,356	2	$4,121,453	$406,068	348.00	83,138	1,569	44
1851-60	......	..	....	... .	......	.....	....	....
1861-70	84,108	4	758.847	46.148	55.50	5,125	541	39
1871-80	106,086	18	2,548,990	202.448	237.85	11,941	1,970	713
1881-85	71,306	29	1,246.612	130,568	142.46	5,468	1,298	11
1886-88	70,470	30	1,245,000	79,295	181.44	4,645	1,536	36
Unknown.	1,783	1	8,000	800	2.00	500	15	....
Total	432,109	84	$9,923,902	$865,327	967.25	60,817	6,929	813
			Illinois.					
1840-50	503,185	1	$11,393.422	$1,529.102	638.23	100,000	5,899	3,273
1851-60	7.834	1	100,000	5,000	4.00	125	30	... ..
1861-70	50,983	3	1,023,000	72,535	83.00	4.950	519	85
1871-80	163,160	24	3,186,153	385,034	417.84	19,432	2,062	68[illegible]
1881-85	126 782	(1) 22	2.656.120	290,633	282.60	19,145	2,061	69[illegible]
1886-88	103.548	37	1,916.918	216,125	150.40	4.743	1,336	21
Total	955,492	(1) 88	$20,305,613	$2,498,129	1,576.07	148,395	11,907	4,761
			Wisconsin.					
1873-80	137.908	4	$3,215.841	$305,190	169.50	15,584	1,394	1,736
1881-85	83,428	13	1.781,228	159,315	154.20	5,069	1,105	56
1886-88	94,150	23	2,789,700	371.070	194.12	5,714	2,031	14
Total	315,486	40	$7,786,769	$835,575	517.82	26,367	4,530	1,806

Table 5-E, showing status by decades, is less interesting and valuable than we hope to make it next year, from the fact that it shows only the *present* status of works first opened in each decade. Next year we shall show the actual status of works at the end of each decade. From the table it appears that the 7 works existing in 185 now represent 35.3 per cent. of the total invested in water-works, leaving only 64.7 per cent. for the remaining 322 works. They also represent 39.3 per cent. of the revenue, 26.3 per cent. of the pipe mileage, 48.3 per cent. of the taps, and 31.4 per cent. of the population supplied.

TABLE 4-E.

NORTH CENTRAL STATES WATER-WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-E.

State.	Pop'n on Water-Works 1880 census.	No. of Works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue		Taps.	Hy-dr'ts	Meters.
Ohio	940,315	73	$25,786,944	$2,030,032	1,447.46	96,042	12,434	4,179
Indiana	367,330	43	5,657,200	529,256	528.15	20,842	4,746	496
Michigan	432,109	84	9,923,902	865,327	967.25	60,817	6,929	843
Illinois	955,492	89	20,305,613	2,496,429	1,576.07	148,395	11,907	4,761
Wisconsin	315,486	40	7,786,760	835,575	517.82	26,367	4,530	1,806
Total No. C.	3,010,732	329	$69,460,428	$6,758,619	5,036.75	352,463	40,546	12,085
T'l So. Atl. & So. C.	1,220,358	128	$27,918,703	$2,491,120	1,023.20	98,636	12,120	5,454
Total Middle	6,165,618	433	156,522,264	15,025,061	7,428.03	890,021	56,005	33,991
Total N. Eng.	2,409,359	287	84,992,725	6,412,624	5,290.70	305,404	32,800	87,913

TABLE 5-E.

NORTH CENTRAL STATES WATER-WORKS—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL NORTH CENTRAL STATES WATER-WORKS, AS GIVEN IN TABLE 3-E.

DATE.	Present pop'n of water-works.	No. of Works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-drants.	Meters.
1820-50	945,851	7	$24,530,243	$2,647,193	1317.23	169,910	10,705	4,600
1851-60	170,710	3	5,213,091	414,654	263.00	23,063	2,622	1,525
1861-70	291,382	17	5,290,981	413,576	411.50	22,255	3,146	858
1871-80	735,789	80	15,093,384	1,414,501	1297.69	70,942	9,280	3,916
1881-85	421,909	87	8,591,811	837,148	848.79	40,588	6,645	978
1886-88	442,092	133	10,722,918	1,028,687	893.54	25,085	8,133	208
Unkno'n	2,909	2	18,000	2,800	5.00	600	85	.....
Total.	3,010,732	329	$69,460,428	$6,758,619	5036.75	352,463	40,546	12,085

N. B.—This table does *not* represent the status of the works at the several dates (except as to number) but the statistics for the *current year* 1888, of works *first opened* at the several dates.

It is not generally realized how much smaller a State Indiana is than Ohio and Illinois, and an examination of Table 4-E and especially Table 7-E shows that its water-works status compares anything but favorably with the rest of the group in other respects likewise. Whether or not this be because its "floaters" prefer to float in some fluid other than water, and have an ingrained antipathy to the latter, we cannot undertake to discuss in these columns.

In Table 6-E Indiana does not show so badly. Its rate of increase in total population has been the smallest of any of the group, and its per cent. of urban population is also the smallest; but the ratio of total population in water-works to the 1880 urban population is above the average of the group, which is singularly uniform. The group as a whole compares as follows with others:

TABLE 6-E.

NORTH CENTRAL STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.]

STATES.	Total Population. 1870	Total Population. 1880	Total Population. Inc. per cent.	Urban Populati'n 1880.	Per cent. of total.	Pop'n on Water-works, 1888. Total by 1880 Census.	Pop'n on Water-works, 1888. P. C. of Total pop'n.	Pop'n on Water-works, 1888. P. C. of Urban pop'n.	Av. pop'n on each water-works.
Ohio	2,665,260	3,198,062	19.9	892,114	27.8	940,315	29.4	105.4	12,880
Indiana	1,680,637	1,978,301	17.7	327,248	16.5	367,330	18.6	112.2	8,520
Michigan	1,184,059	1,636,937	38.2	353,230	21.6	432,109	26.3	122.3	5,140
Illinois	2,539,891	3,077,871	21.1	844,462	27.4	955,492	31.1	113.1	10,740
Wisconsin	1,054,670	1,315,497	24.7	272,733	20.7	315,486	24.0	115.7	7,887
Total No. C.	9,124,517	11,206,668	22.8	2,689,787	24.0	3,010,732	26.9	111.9	9,140
Tot. So. Atl. & So. C.	9,947,361	12,863,119	58.8	1,140,015	8.9	1,220,358	9.5	107.1	9,530
do. Middle	9,848,415	11,756,053	19.4	5,538,720	47.2	6,165,618	52.5	113.1	14,220
do. New England	3,487,924	4,010,529	15.0	1,989,339	49.6	2,409,359	59.8	120.6	8,391

	No. C.	So.	Mid.	N. Eng.
Per cent. of pop'n on water-works, to 1880 urban pop'n	111.9	107.1	113.1	120.6
Per cent. of urban to total population	24.0	8.9	47.2	49.6
Total pop'n, 1880, millions	11.206	12.863	11.756	4.011

This shows that, while comparison of water-works with the total population would show very great inequality, in proportion to town population the groups show a very remarkable uniformity of conditions. Table 7-E shows the proportion of towns of various size supplied

TABLE 7-E.

NORTH CENTRAL STATES.—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.*

STATES.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over.	Total No.
Ohio	4	13	20	21	8	6	72
Indiana	1	9	13	10	5	4	42
Michigan	15	35	14	10	5	3	82
Illinois	11	35	10	19	11	3	89
Wisconsin	4	10	11	7	7	1	40
Total No. Cent.	35	102	68	67	36	17	325
T'tal So. Atl. & S. C.	21	39	14	22	11	15	122
do. Middle	47	174	78	78	24	32	433
do. New Eng.	40	80	65	48	35	19	287

* 1 duplicate system in Ohio, 1 in Indiana, and 2 in Michigan reduce the totals by so much. Separate towns supplied by one system are regarded as one town.

with water-works, the number of water-works in towns of 3,000 or under being in

Ohio	17	or	23.6 per cent.
Indiana	10	"	23.8 "
Michigan	50	"	60.9 "
Illinois	46	"	51.7 "
Wisconsin	14	"	35.0 "

Michigan is decidedly the banner State of the West for small works, probably in part owing to more and better sources of supply, which may be noted in Table 10-E. The group as a whole compares with other groups as follows:

	No. Cent.	Southern.	Middle.	New Eng.
Towns of 1,000 or under	10.8	17.2	10.9	13.9
" 3,000 "	42.2	49.1	51.0	41.8
" 5,000 "	63.0	60.6	69.0	64.8
" 10,000 "	88.8	78.6	87.0	81.2

The proportion of small works is still small, even by the 1880 population, and if we could use the 1888 population for each section, the relative proportion of small works would appear smaller, since the towns of this group have presumably been increasing faster in population than either the South or the Northeast. We have a shrewd suspicion, however, based on the indications of these statistics, that the politicians are going to have another surprise in 1890 like that which they had in 1880, by finding that the growth of population in the South has been very much faster than was expected. We shall be surprised if the Southern groups have not increased considerably faster than the North Central.

The list of towns in this group which had 4,000 population or over, in the 1880 census, but still have no water-works, is longer than in any other group, despite the presumably greater growth since 1880, to which we have just alluded. No less than 15 towns, aggregating 77,519 population in 1880, are included in this list, only one of them having projected works, against only 6 such towns in the South, two of which had projected works, and an equally short list in the other two groups. The list of these towns is as follows. Some of them may be improperly included by omissions on our part, but if so, we shall be pleased to be advised of that fact. The term "indefinite" means that projects have been reported for them, but appear to have fallen through.

Gallipolis,	Ohio	4,400	(indefinite)
Marietta	"	5,444	"
Pomeroy	"	5,500	(projected)
Van Wert	"	4,079	
Aurora,	Ind.	4,435	
Lawrenceburg,	"	4,668	
Seymour	"	4,250	(indefinite)
Coldwater,	Mich.	4,681	"
Monroe	"	4,930	
Ypsilanti	"	4,984	(indefinite)
Braidwood,	Ill.	5,524	
La Salle,	"	7,847	
Peru	"	4,632	
Neenah,	Wis.	4,202	
Watertown	"	7,883	
		77,519	

Table 8-E, showing cost and revenue per head, tap, etc., gives the fairest basis of comparison of the States and groups thereof, and in this Indiana's rank is low. Its investment per head in water-works is among the smallest in the Union, only two of the Southern States falling below it, most being far above; its works are likewise among thecheapest, as shown by the cost per mile of main. No Southern State, and in New England only New Hampshire and Vermont, which have many small works, fall so low in this item. As a natural consequence of this fact the population per

TABLE 8-F.
NORTH CENTRAL STATES WATER-WORKS.— · OST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

STATE.	Cost per			Revenue per			Population on water works.		P. C. rev. to cost.
	head on water-works.	mile of main.	tap.	head on w'ter w'ks.	mile of main.	tap.	per tap.	per meter.	
Ohio	$27 40	$17,800	$268	$2.16	$1,402	$21.20	9.8	225	7.87
Indiana	15.38	10,720	272	1.32	1,002	25.30	17.6	730	9.36
Michigan	22.90	10,260	163	2.00	895	14.22	7.1	511	8.73
Illinois	21.27	12,840	137	2.62	1,5-5	16.84	6.4	200	12.31
Wisconsin	24.65	15,030	295	2.14	1,614	31.68	12.0	194	10.74
Av. No. Cent.	$23.10	$13,780	$197	$2.24	$1,328	$19.18	8.5	250	9.72
do. Southern	$22.80	$17,1	$283	$2.04	$1,533	$25.30	12.4	224	8.93
do. Middle	25.40	21,0	176	2.43	2,023	16.90	6.9	181	9.40
do. New Eng	35.30	16,0	269	2.66	1,213	20.30	7.6	63	7.54

tap is very high, 17.6—more than double the average for the group—indicating that only a small portion of those potentially supplied actually use the water. The seeming paradox of many "floaters" and little water, to which we have already alluded, we leave every one to explain for himself. Compared with Ohio and Michigan, Indiana's revenue from its water-works is good, but the revenue per head and mile of main is low. Indiana is also by far the most backward State in the group in respect to the use of meters, although the group as a whole uses fewer meters than any of the other groups, as will be seen from the last four lines of the table. One does not gather an altogether favorable opinion of Indiana as a progressive State from these statistics, nor from some which follow.

Taking the groups as a whole, the cost of works per head is quite uniform at $23.50, New England being high at $35.30. The cost per mile of main is cheap in the North Central group ($13,780 against $16,080 to $21,000) doubtless because of the absence of costly reservoirs and conduits. The cost per tap is highest in the Southern States and New England ($283 and $269) and lowest in the Middle group ($176 against $197 in the North Central). The revenue per head is singularly uniform in all the groups ($2 to $2.66); the revenue per tap ($16.90 to $25.30) lowest in the Middle States and highest in the South, and the total revenue per cent. highest in the North Central group, 9.72 per cent. against 9.40 Middle, 8.93 Southern and 7.54 New England.

Table 9-E shows a somewhat striking contrast in respect to kind of works. There are only 16 gravity works out of 331, or 4.8 per cent. in the whole group, against 13.1 per cent. in the South, 42.4 per cent. in the Middle, and 50.4 per cent. in the New England tes. Indiana has no gravity works and Michigan and Illinois only 5 between them. Direct pumping works here first become the predomnating type, and works pumping to reservoir the rare exception. The broad contrast between the sections is shown in the following table, which concerns pumping works only.

TABLE 9-E.

NORTH CENTRAL STATES WATER-WORKS—KIND OF WORKS.

STATE	Gravity	Pumping to				Unkno'n	Total	P. C. gravity works
		Reservoir.	Tank	Stand-Pipe	Direct			
Ohio......	5	15	7	19	23	2	71	7.0
Indiana....	....	7	4	11	21	....	43	0.0
Michigan..	2	8	6	6	62	1	85	2.4
Illinois..........	3	12	30	24	21	1	91	3.3
Wisconsin	6	4	4	12	14	1	41	14 6
Total N. Central	16	46	51	72	141	5	331	4.8
do. Southern	17	35	24	34	15	5	130	13.1
do. Middle. .	175	116	23	44	40	4	412	42.4
do. New Eng	130	50	21	31	21	5	258	50.4

Some of the works have a double system which increases the total. Several gravity works have small auxiliary pumping systems for special service which have been disregarded. Most of the pumping works pump direct in case of fire.

Per cent. of works pumping to	*Reservoir*	*Tank.*	*Stand-Pipe.*	*Direct.*	*Total*
North Central....	14·8	16·5	23.2	45·5	100·0
Southern.	32·4	22·2	31.5	13·9	100·0
Middle......	49·8	14.1	18·9	17·2	100·0
New England.....	40·6	17.1	25·2	17.1	100·0
Michigan	9.8	7·3	7·3	75·6	100.0
Illinois...............................	13·8	34·5	27.6	24.1	100·0

The two States given last illustrate the extremes of the North Central group. Michigan has hardly any but direct pumping works; Illinois chiefly tanks and stand-pipes. Why this should be, we cannot explain. It is notable that in Illinois nearly all the direct pumping works are of old date. Before 1880 14 out of 27 pumping works were direct; since 1880 only 7 new pumping works have been built against 53 works pumping to reservoirs, tanks, or stand-pipes. The same tendency is visible in Wisconsin. Indiana continues to favor direct pumping, and so does Michigan.

The sources of supply, shown in Table 10-E, likewise show a very marked contrast. Not less than 41.5 per cent. of the works depend on wells for a supply, largely artesian wells. Some of these wells are only 400 ft. deep; the deepest, 2,000 to 2,510 ft., so far as our records show. Wisconsin has no less than five "gravity" works supplied from wells without pumping, the wells flowing out under pressure so as to give in one case 43 lbs. per sq. in. pressure, in the mains. There are two or three other such works in other States of the group.

Surface supply is hardly used at all in this group, and springs very little, only 12 per cent. of the works depending on either, against about 36 to 33 per cent. in the other groups.

The lake supplies are numerous only in Michigan and Wisconsin, and more than half those classed as lake, draw from the Great Lakes. Of brook supplies, there is not a single one, for the good reason that there are few or no brooks in this region fit for water supply. Only in a hilly region are brooks sufficiently pure and constant. Rivers and creeks supply about one-third of the works in all the groups but New England.

TABLE 10-E.

North Central States water-works—Sources of Supply.
[Some works have a double source of supply, which increases the total for some States.]

State	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Ohio........	3	10	....	20	5	3	31	2	74
Indiana.. .. .	3*	5	....	17	3	3	11	1	43
Michigan	2	8	.. ..	16	20	4	34	....	84
Illinois..........	2	4	....	21	8	3*	47	5	90
Wisconsin	. ...	3	....	13	8	2	15	1	42
Total N. Central	10	30	3	87	44	15	138	9	333
Per cent........	3.0	9.0	....	26.1	13.2	4.5	41.5	2.7	100.0
" Southern	3.1	23.4	4.7	29.7	4.7	8.6	21.9	3.9	100.0
" Middle	8.3	25..	10.7	21.6	4.4	14.8	14.1	1.0	100.0
" New Eng..	14.0	17..	16.3	14.0	†27.1	....	7..	3.5	100.0

Some works have duplicate sources of supply, increasing the totals somewhat above the number of works.

*Including one "canal" supply.

†Including 14.7 per cent. of so called "ponds," really lakes.

The average working pressures, shown in Table 11-E, range somewhat lower than the average of other sections, the larger number being between 40 and 50 lbs. The fire pressures, Table 12-E, are some of them very high. A much larger total of works than in any other section are arranged to give higher fire pressures, 198 out of 310 pumping works reporting such, while it is quite certain that

TABLE 11-E.

North Central States water-works—Average working pressures.
[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence, considerably higher than the effective pressure.]

Pressure per square inch	Ohio.	India	Michig'n	Illinois.	Wisconsin.	Total
Under 20	1	....	1	1	....	3
20-29	1	2	3	1	2	9
30-39.....	4	4	13	9	3	33
40-49.....	10	13	34	17	7	81
50-59	9	6	3	9	3	30
60-69.....	8	4	12	10	4	38
70-79.....	11	4	4	7	3	29
80-89	4	2	1	6	1	14
90-99	4	....	2	2	3	11
100-109....	3	....	....	1	2	6
110-119....	2	1	....	....	....	3
120-129....	1	....	....	....	....	1
130-139....	....	....	....	....	....	....
140-149....	....	....	....	....	....	....
150-159 ...	....	....	1	....	....	1
Total works reporting	58	36	74	63	28	259

Average Pressure, lbs. 56.5
" New England 72.5
" S. Atlantic .. 62.0

Average Middle States. . 68.3
" S. Atlantic 66.2

many of those which do not specifically report fire pressures really have a higher one. The bulk of the fire pressures are between 70 and 130 lbs., but a large number run from that to 200 lbs. The excess above normal pressure ranges from 30 to 90 lbs. for the most part; but Canton, Ill., for example, ranges from 38 working to 200 lbs. fire pressure.

TABLE 12-E.

FIRE PRESSURE OF NORTH CENTRAL STATES WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURE. lbs. per sq. in.	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.
30–39	....	....	....	....	....	....
40–49	....	....	....	....	1	1
50–59	....	1	....	....	....	1
60–69	....	....	4	2	1	7
70–79	1	2	2	3	....	8
80–89	6	6	13	2	2	29
90–99	7	4	9	3	1	24
100–109	7	10	21	9	5	52
110–119	1	....	2	3	1	7
120–129	5	5	4	8	4	26
130–139	....	1	2	2	1	6
140–149	1	....	2	2	2	7
150–159	7	2	1	9	1	20
160–169	1	....	1	3	....	5
170–179	....	1*	....	4†	....	5
Total works reporting.	36	32	61	50	19	198

* 200 lbs. † 2 of these, 200 lbs.; 1, 185 lbs.

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.
10 lbs. or under	....	....	1	....	2	3
10–19	2	1	....	1	....	4
20–29	3	4	3	6	....	16
30–39	2	2	4	4	3	15
40–49	6	4	16	4	7	37
50–59	11	6	12	3	3	35
60–69	4	6	13	9	1	33
70–79	7	6	6	7	1	27
80–89	....	2	3	3	1	9
90–99	1	....	....	2	1	4
100–109	....	....	....	5	....	5
110–119	....	....	....	2	....	2
120–129	....	1	2	2	....	5
130–139	....	....	1	2*	....	3
Total works reporting.	36	32	61	50	19	198

* 148 and 155 lbs.

Table 13-E, showing the ownership of the works, shows likewise some striking contrasts. No group gives such a heavy per cent. of public works as this, as shown in the following comparison, the " population " spoken of being the 1880 population of the present water-works towns:

	No. Cen.	So. Atl.	So. Cen.	Middle	New Eng.
Per cent. public works, by no....................	64.5	56.3	23.6	33.5	41.4
" " by pop'n supplied....................	74.6	64.4	21.5	78.3	72.3
Pop'n per private works....................	6,485	6,900	13,080	4,930	3,980

Indiana compares badly with the other States of the group, in this as in other details; 55 per cent. of its water-works population has had to trust to private enterprise for water against only 15 per cent. in Ohio, and [illegible] per cent. in Illinois. Indianapolis is, with two exceptions San Francisco and New Orleans, the largest city in the country which has trusted to private enterprise for its water-supply and there are several other large towns so supplied. Michigan is conspicuous for the number of small public works, leading all

TABLE 13-E.

OWNERSHIP OF NORTH CENTRAL STATES WATER-WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	O.	Ind.	Mich.	Ill.	Wis.	Total.
City or town	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Local company	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Outside company	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
Individuals	[illegible]		[illegible]	[illegible]		[illegible]
Unknown	[illegible]					[illegible]
Total Number	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Population supplied by public works	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P. C. of urban supplied by city works	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pop. in private works	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pop. per private work	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P. C. of persons city works supplied by public wks	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

the States so far reviewed in all the groups, very largely. Wisconsin has trusted extensively to private enterprise, and especially to outside companies, having an unusually large number of the latter. The number of *de facto* outside companies is larger in all the States than is indicated by our returns, however, the name only being local sometimes, while the works are really controlled as an outside investment. A strong argument may be made in favor of small towns

TABLE 14-E.

NORTH CENTRAL STATES WATER-WORKS REPORTING OVER 100 METERS IN [illegible]

						Summary	
Cleveland, O.	1,525	Bay City, Mich	190	Joliet, Ill	305		
Cincinnati, "	1,280	East Saginaw, Mich	[illegible]				
Columbus, "	480	Grand Rapids, "	[illegible]	19 others	402		
Toledo, "	325			(64 without meters)			
		14 others	133			Wks	Meters
	3,610	(67 without meters)		Total, Illinois	[illegible]		
22 others	569						
(48 without meters)		Total, Michigan	843	Milwaukee, Wis	1,728		
						16	[illegible]
Total, Ohio	4,179	Chicago, Ill	[illegible]	13 others	78	30	[illegible]
		Quincy, "	175	(20 without meters)		[illegible]	
Indianapolis, Ind.	150	Jacksonville, Ill	186				
Ft. Wayne, "	133	Bloomington, "	175	Total, Wisconsin	1,806	[illegible]	[illegible]
		Pullman, "	125				
12 others	213						
(29 without meters)							
		In Middle States					[illegible]
Total, Indiana	496	In New England					37,013
		In South Atlantic States					[illegible]
		In South Central States					[illegible]

TOWNS HAVING OVER ONE-SIXTH OF THEIR TAPS METERED

	p. c. metered.		p. c. metered
Brooklyn, O	52.2	Bloomington, Ill	10.4
Grand Rapids, Mich	22.8	Joliet, Ill	91.2
Jacksonville, Ill	53.7	Oak Park, Ill	35.0

trusting to private enterprise for water-works, as really cheaper for them, but the same can hardly be said of large works.

In use of meters, Table 14-E, this group is backward, as we have noted. There are only 6 towns in the whole group, with as many as one-sixth of their taps metered, and only one of these is a large place. Most of the large cities have but very few meters.

TABLE 15-E.

NORTH CENTRAL STATES WATER-WORKS—HYDRANT RENTAL.
(Nearest even $5 taken.)

Hydrant rate.	O.	Ind.	Mich.	Ill.	Wis.	Total No. C.	Sot h'n	Midd.	N.E.
Free							1	11	14
$5								8	1
10								10	6
15		1				1	1	16	11
20					1	1		10	11
25	1					1	3	13	7
30		1		1	3	5	1	10	17
35	4	2				6	3	9	8
40	1	2		1	3	7	7	17	13
45	4	2	1	2	4	13	2	8	4
50	2	3	4		1	10	14	20	16
55	1	2		1	1	5	2	1	
60	2	1	3	2	1	9	9	5	1
75	1	3	4	5	5	18	4	1	1
90	2	1				3		1	
100			2	1	1	4		1	
Total	18	18	14	13	20	83	47	141	110

The above includes all the works which report a hydrant rental separately. Nearly all the private works receive an indirect rental of some stated sum including water supply of city buildings, etc. Some of the works have a sliding scale decreasing from the above rates for additional hydrants.

Hydrant rentals, Table 15-E, range high. The most common rate is $75, and the average decidedly higher than in any of the other groups. The general average is somewhat over $55.

The different kinds of pumping machinery are shown in Table 16-E. As is to be expected, the aggregate pumping capacity is very large, aggregating 1,167.3 millions of gallons daily capacity, against 366.1 in the South Atlantic and South Central groups, 981.2 millions in the Middle group, and 342.1 in New England. The extent to which the selection of makes of pumps is influenced by merely local causes or examples is very notable. Thus, the Walker pump is one generally used in Michigan, but not appearing at all in any of the other States. Possibly there may be some Walker pumps included among he "miscellanecus" of other States, from the make not being specified, as under that head a considerable variety of pumps are included, such as water-power pumps, large pumps of local design, or by other than regular pump-makers, pumps of unknown or unreported makes, etc.

The Holly-Gaskill pumps have a large lead in this group, 108 pumps with 276.8 million gallons' capacity against 85 Worthington pumps with 145.0 millions gallons. In all the five groups so far reviewed, however, which include practically all the States east of the Mississippi River, the totals are:

	Million galls. daily capacity
Worthington	700.8
Holly-Gaskill	532.2
Deane	187.1
Blake	137.4
Knowles	132.0
Davidson	49.2
Other smallbr mauers	371.3
Miscellaneous	746.7
Total, east of Mississippi River	2,856.7

The Deane pump is very much used in all the North Central States, in two of them leading the Worthington. The latter lèads the Holly in Ohio only, and in Indiana, Michigan, and Wisconsin is little used, while in Illinois it is a very good second. Why such noticeable differences should occur in contiguous States is a conundrum which we cannot guess.

TABLE 16-E.

NORTH CENTRAL STATES WATER-WORKS—PUMPING MACHINERY.

Makes of Pumps arranged alphabetically	No. of Pumps.						Capacity, millions of gallons.								
													Totals.		
	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.	Ohio.	Ind.	Mich.	Ill.	Wis.	Total.	So.	Mid.	N. E.
Blake	5	1	7	12	5	30	9.0	2.0	11.5	16.5	12.5	61.5	38.4	26.1	21.4
Cameron	....	..	....	3	..	3	......	......	....	3.0	......	3.0	......	1,6	......
Corliss	....	..	....	...	..	...	......	......	......	......	......	......	......	22.0	20.0
Cornish	8	..	....	...	..	8	75.0	......	......	......	......	75.0	....	19.3	9.0
Davidson	....	..	2	...	..	2	......	......	3.5	......	......	3.5	5.0	28.7	12.5
Deane	11	14	11	27	11	74	15.0	23.1	8.5	23.4	15.0	85.0	43.2	19.4	39.5
Galloway	....	..	....	...	..	...	......	......	......	......	......	......	......	6.0	......
Gordon & Maxwell	19	5	3	11	3	41	32.5	5.0	3.0	19.8	2.0	62.3	12.6	8.5	......
Holly-Gaskill	19	27	29	23	10	108	48.5	64.5	60.0	75.8	28.0	276.8	81.0	156.9	17.5
Knowles	11	1	4	5	3	24	45.0	0.1	2.1	10.0	5.2	62.4	18.0	32.1	19.5
Lang	....	..	....	...	..	...	......	......	......	......	......	......	......	8.2	6.5
Lowery	1	..	....	...	..	1	2.0	......	......	......	......	2.0	......	10.0	......
Smith & Vaile	5	..	3	3	4	15	6.8	......	3.0	0.3	8.0	18.1	4.0	......	......
Volker & Felth'sen	....	..	....	...	..	...	......	......	......	......	......	......	......	5.5	......
Walker	....	..	39	...	..	39	......	......	31.6	......	......	31.6	......	......	......
Wetherill	....	..	....	...	..	...	......	......	......	......	......	......	......	12.0	......
Wood	....	..	....	...	..	...	......	......	......	......	......	......	5.0	6.0	9.5
Worthen	....	..	....	...	..	...	......	......	......	......	......	......	......	5.5	......
Worth'g'n	26	12	11	31	5	85	57.1	13.3	12.1	54.5	8.0	145.0	87.4	344.6	123.8
Wilson & Snyder	....	..	....	...	..	...	......	......	......	......	......	......	1.0	6.6	......
Miscell's	21	10	10	24	11	76	54.0	22.5	89.8	148.8	36.0	351.1	70.5	262.2	62.9
Totals	126	70	119	139	52	506	344.9	130.5	225.1	352.1	114.7	1167.3	366.1	981.2	342.1

NOTE. The "Southern" total includes only the South Atlantic and South Central groups; not the Southwestern.

It is notable that most of the large cities, including all the very large ones of this group, have most or all of their pumps specially designed for them, and do not patronize any of the well-known builders. In part, the reason for this is easily understood.

The dams and reservoirs in this group are few and mostly small affairs. The most extensive dams are, a stone dam from Moline to Rock Island, built by the U. S. Government, 4,000 ft. long, 20 ft. high, 8 ft. wide at base, and 4 ft. wide at top, and a dam at Cincinnati only 1,251 ft. long, but 119 ft. high, 22 ft. wide at top, and 48½ ft. wide on the base. There is a 200,000,000 galls. reservoir capacity at Cincinnati and 118,000,000 galls. at Cleveland; but for the most part reservoirs are dispensed with throughout the group, for the very good reason often that there is no site to put one on.

The only tunnels of any importance are those run out under the shores of the Great Lakes to get water free from shore pollution. Of these there is an increasing number. The most important ones are, two at Cleveland, about 1¼ miles long each, and of 5 and 7 ft. diameter, the last built in 1888 and having a capacity of 115,000,000 galls. daily; three at Chicago, of 2 miles, 6 miles, and 4 miles length respectively, and 5 and 7 ft. diameter; and one at Hyde Park, Ill., 1½ miles long and 6 ft. diameter. Another one, 6,000 ft. long and of 9 ft. diameter, is proposed at Lake View, Ill., and before long there will probably be several others. Many towns, like Milwaukee, are now relying on pipes laid out under water. At Bay City, Mich., there is an interesting and successful wooden conduit of this kind, over 4 miles long and 30 ins. diameter, made of pine staves 3 ins. thick and 4 to 6 ins. wide, in 8-ft. sections, as more fully described in our account of the works. As a whole, the water-works of the North Central States are highly creditable to them, and ten years hence will be still more so.

THE WATER-WORKS OF THE FAR WEST.

Under this general term we include the three groups of Northwestern, Southwestern and Pacific, which includes all the trans-Mississippi States and Territories except Louisiana, which is bisected by the Mississippi (but with most of its area on the western side of the river) and included in with the South-Central group.

If we exclude from this vast area the most easterly tier of States in it, Minnesota, Iowa, Missouri and Arkansas, the remainder constitutes somewhat more than half the total area of the United States, but until very recently it has been very thinly populated, as the following figures show.

	Area. 1 = 1,000,000 sq. m.	Population of U. S. Census. (1 = 1,000) 1880	1870	1860	1850
Minn., Ia., Mo., Ark	256.0	5,378	3,839	2,464	1,090
Far West (west of above States)	1,862.1	4,943	2,311	1,364	391
Total of 3 Far West groups....	2,118.1	10,321	6,150	3,828	1,481
Total U. S	3,026.5	50,155	38,558	31,443	23,192

		Population.			
PERCENTAGES.	Area.	1880	1870	1860	1850
Minn., Ia., Mo., Ark	8.5	10.7	10.0	7.8	4.7
West of do	61.5	9.8	6.0	4.3	1.7
Total of 3 Far West groups ...	70.0	20.5	16.0	12.1	6.4
Total U. S	100.0	100.0	100.0	100.0	100.0

From this it will be seen that the population of this entire far west region, including 70 per cent. of the whole area of the United States, was in 1880 a trifle over *one-fifth*, of that of the whole country, and this population was about equally divided between the tier of the four most easterly States bordering on the Mississippi and the vast area west of it nearly eight times as large. At the present time, assuming the population to be increasing on that of the rest of the United States about in the past ratio, the far west as a whole should include about a quarter of the U. S. population, but not more.

This being so, it is instructive to compare with the above figures

TABLE 1—F-G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES WATER-WORKS.—SUMMARY BY DATES OF CONSTRUCTION.

TABLE 1—F. NORTHWESTERN STATES.

Year.	Iowa	Minn.	Kans.	Neb.	Dak.	Wyo.	Mont.	Total.
1867	....	1	....	....	....	1	....	1
1870	....	1	....	....	....	....	....	2
1871	2	....	....	....	....	....	....	2
1872	....	....	....	....	....	....	....	....
1873	....	....	....	....	....	....	....	....
1874	2	....	....	....	....	....	....	2
1875	1	....	....	....	....	1	....	2
1876	4	1	(1)	....	....	....	....	(1) 5
1877	1	....	....	....	....	....	....	1
1878	4	....	....	....	....	....	....	4
1879	1	1	....	....	1	....	....	3
1880	....	1	1	....	1	1	....	4
1881	4	1	....	1	....	....	....	6
1882	3	2	7	....	1	....	....	13
1883	7	5	4	....	1	....	2	19
1884	9	3	3	1	4	....	....	20
1885	1	....	4	1	3	....	....	9
1886	3	....	8	5	6	....	....	22
1887	5	2	17	11	3	....	1	39
1888	4	2	24	23	5	1	3	62
Unk'wn.	2	....	3	....	1	1	1	8
Total.	53	20	(1) 71	42	26	5	7	(1) 224

(Table 1-G-H on following page.)

the water-works statistics for this region, which will be seen from the accompanying Tables 1, 2, and 4 to stand as follows.

	Pop. on W. W.'s [1 = 1000]	No. water-works	Cost [1 =	Revenue $1,000]	Miles mains	No. taps.	No. meters
Minn, Ia., Mo., Ark	977	110	34,211	3,083	1,406	87,467	12,408
West of do	1,075	380	59,120	5.592	3.472	144,753	15,042
Total Far West.........	2,052	490	93.381	8,675	4.878	232.220	27.450
Total Eastern	12.806	1,177	338,894	30,688	19 379	1,840,524	141,061
Total U. S	14,858	1,667	432,225	39,363	24,257	2,089,544	168,511
PERCENTAGES.							
Minn., Ia., Mo., Ark....	6.6	6.6	7·9	7·8	5.8	4·2	7·4
West of do	7.2	22·8	13·7	14·2	14·3	6.9	8.9
Total Far West........	13·8	29·4	21·6	22·0	20·1	11·1	16.3
Total Eastern	86.2	70·6	78·4	78·0	79·9	88.9	83·7
Total U. S	100·0	100·0	100.0	100·0	100·0	100.0	100·0

It will be seen at once, by studying those statistics that as between the Minnesota-Arkansas tier of States and the great area west, the two having about equal population, the latter is vastly the most progressive, having over three times as many water-works and nearly three times as many miles of mains as the easterly tier of States. The indications from these facts are very strong that the extreme far west has been growing with great rapidity since the census of 1880; much more so than is generally imagined.

This is still more evident from a comparison of the far west as a whole and the eastern United States. There is at most something like one-quarter of the U. S. population in that region, and that the newest and most unsettled part of it, busily occupied in the heavy work of subduing a continent. It would be entirely natural that the water-works should be disproportionately few and cheap in that region, especially in view of the small number of large towns in it; yet as a matter of fact nearly 30 per cent. of the water-works are out there, and even the capital invested is in full proportion to the Eastern United States.

TABLE 1-G. SOUTHWESTERN STATES.

Year.	Mo.	Ark.	Tex.	Colo.	N. M.	Total.
1821-30	1	…	…	…	…	1
1831-40	…	…	…	…	…	…
1841-50	…	…	…	…	…	…
1851	…	…	…	…	…	…
1852	…	…	…	…	…	…
1853	…	…	…	…	…	…
1854	…	…	…	…	…	…
1855	…	…	…	…	…	…
1856	…	…	…	…	…	…
1857	…	…	…	…	…	…
1858	…	…	…	…	…	…
1859	…	…	…	…	…	…
1860	…	…	…	…	…	…
1861	…	…	…	…	…	…
1862	…	…	…	…	…	…
1863	…	…	…	…	…	…
1864	…	…	…	…	…	…
1865	…	…	…	…	…	…
1866	…	…	…	…	…	…
1867	…	…	…	…	…	…
1868	…	…	…	…	…	…
1869	…	…	…	…	…	…
1870	…	…	…	…	…	…
1871	1	…	…	…	…	1
1872	…	…	…	1	…	1
1873	1	…	…	…	…	1
1874	…	…	…	1	…	1
1875	…	…	1	2	…	3
1876	…	…	1	…	…	1
1877	…	…	…	…	…	…
1878	…	1	1	…	…	2
1879	…	…	2	4	…	6
1880	3	…	…	2	…	5
1881	1	…	…	2	1	4
1882	1	1	2	4	1	9
1883	3	…	6	4	1	14
1884	…	1	13	2	…	16
1885	7	1	4	…	…	12
1886	3	…	4	3	1	11
1887	2	2	3	5	2	14
1888	(1)3	4	13	8	1	(1) 29
Unk'n.	…	…	1	(1)2	…	4
Tot'l.	(1)26	10	51	(1)40	7	(1)135

TABLE 1-H. PACIFIC STATES.

Year.	Wash.	Ore.	Cal.	Ariz.	Nev.	Utah.	Idaho.	Total.
1821-30	…	…	1	…	…	…	…	1
1831-40	…	…	1	…	…	…	…	1
1841-50	…	…	…	…	…	…	…	…
1851	…	…	…	…	…	…	…	…
1852	…	…	…	…	…	…	…	…
1853	…	…	2	…	…	…	…	2
1854	…	…	…	…	…	…	…	…
1855	…	…	…	…	…	…	…	…
1856	…	…	…	…	…	…	…	…
1857	…	…	1	…	…	…	…	1
1858	…	1	…	…	…	…	…	1
1859	…	…	2	…	…	…	…	2
1860	…	…	…	…	…	…	…	…
1861	…	…	1	…	…	…	…	1
1862	…	1	2	…	…	…	…	3
1863	…	…	…	…	…	…	…	…
1864	…	…	1	…	…	…	…	1
1865	1	…	3	…	1	…	…	5
1866	1	…	1	…	…	…	…	2
1867	…	…	1	…	…	…	…	1
1868	1	…	1	…	…	…	…	2
1869	…	…	1	…	1	…	…	2
1870	…	…	2	…	…	…	…	2
1871	…	1	3	…	3	…	…	7
1872	…	…	1	…	…	…	…	1
1873	…	…	3	…	1	…	…	4
1874	…	…	3	…	1	1	…	5
1875	…	…	4	…	…	…	…	4
1876	…	…	5	…	…	…	…	5
1877	…	…	(1)1	…	1	…	…	(1) 2
1878	…	…	(1)2	…	…	…	…	(1) 2
1879	…	…	1	…	…	…	…	1
1880	…	1	2	…	…	2	…	5
1881	…	…	1	1	…	…	…	2
1882	…	1	3	1	1	1	1	8
1883	…	1	3	…	…	…	…	4
1884	2	1	1	1	…	…	1	6
1885	…	…	2	…	…	…	1	3
1886	…	3	2	…	…	…	…	5
1887	…	3	6	…	…	…	1	10
1888	3	4	12	1	1	…	…	21
Unk'n.		…	3	…	1	…	…	4
Tot'l.	8	17	(2)78	4	11	4	4	(1) 226

Neglecting the Mississippi tier of States (Minnesota-Arkansas) altogether the contrast between the far west and the east become still more remarkable. That tier averages closely with the easterly region. The extreme far west, west of it, ought to contain now a little over 12½ per cent. of the U. S. population, judging by past ratios of growth, and a much smaller proportion than that (see Table 6) of the urban population in towns of 4,000 or over. Yet it has already 23 per cent. of the water-works, and 14 per cent. of the cost, revenue and miles of mains. Making all allowances for the unbounded enterprise of this region, these statistics afford very strong evidence that the 1890 census will show an enormous influx of population into this section since 1880, far beyond past ratios.

TABLE 2-F-G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES WATER-WORKS.—SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

TABLE 2-F.—NORTHWESTERN STATES.

DATE.	Ia.	Minn.	Kan.	Neb.	Dak.	Wyo.	Mont.	Total.
1867-70		2				1		3
1871-75	5					1		6
1876-80	10	3	(1) 1		2	1		(1) 17
1881-85	24	11	18	3	9		2	67
1886-89	12	4	49	39	14	1	4	123
Unknown.	2		3		1	1	1	8
Totals.	53	20	(1) 71	42	26	5	7	(1) 224

TABLE 2-G.—SOUTHWESTERN STATES.

DATE.	Mo.	Ark.	Tex.	Colo.	N. M.	Total.	Grand Total 3 Groups.
1830	1					1	[Prior to 1871] 31
1871-75	2		1	4		7	34
1876-80	3	1	4	6		14	(3) 46
1881-85	12	3	25	12	3	55	145
1886-89	(1) 8	6	20	16	4	(1) 54	(1) 218
Unknown.			1	3		4	16
Totals.	(1) 26	10	51	41	7	(1) 135	(4) 485

TABLE 2-H.—PACIFIC STATES.

DATE.	Wash.	Ore.	Cal.	Ariz.	Nev.	Utah.	Idaho.	Total.
1821-30			1					1
1831-40			1					1
1841-50								
1851-55			2					2
1856-60		1	3					4
1861-65	1	1	7		1			10
1866-70	2		6		1			9
1871-75		1	14		5	1		21
1876-80		1	(2) 11		1	2		(2) 15
1881-85	2	3	10	3	1	1	3	23
1886-89	3	10	20	1	1		1	36
Unknown.			3		1			4
Totals.	8	17	(2) 78	4	11	4	4	(2) 126

In all three of these groups there are only three towns which had 4,000 population or over in 1880 which have no water-works reported, and at two of these works are now projected. These towns are:

	Pop'n 1880
Creston, Iowa	5,081 (works projected.)
Warrensburg, Mo	4,049
Brownsville, Texas	4,938 (works projected.)

The number of works projected with fair prospects of construction in the different States are:

Iowa	8	Missouri	2	Washington	4
Minn	1	Arkansas	2	Oregon	2
Kansas	6	Texas	8	California	3
Nebraska	3	Colorado	5	Arizona	..
Dakota	3	New Mexico	..	Nevada	..
Wyoming	1			Utah	..
Montana	..	Total S. W	17	Idaho	..
Total N. W	22			Total Pacific	9

Total of Far West Groups 48

Total Eastern (N. Eng., 25, Middle, 19, So. Atl. and So. C., 40, No. Cen., 21.) 105

TABLE 4 F G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES WATER WORKS—SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-F-G-H.

TABLE 4-F.—NORTHWESTERN GROUP.

STATE.	Pop'n on Water-Works 1880 census.	No. of works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
Iowa	262,396	53	6,154,137	606,306	352	15,226	2,935	1,421
Minnesota	147,866	20	5,484,151	502,885	345	15,379	3,265	5.8
Kansas	129,916	(1) 71	4,176,200	412,649	311	11,134	2,121	513
Nebraska	89,850	43	4,596,800	367,560	247	7,491	2,215	468
Dakota	23,723	26	1,125,444	111,185	92	3,178	479	467
Wyoming	8,695	5	483,000	27,500	44	1,090	176	......
Montana	9,587	7	577,000	76,600	47	2,040	230	......
Total No. W'n	672,033	(1) 225	22,596,732	2,104,645	1,438	55,538	11,411	3,447

TABLE 4-G.—SOUTHWESTERN GROUP.

STATE.	Pop'n on Water-Works 1880 census.	No. of works.	Cost.	Revenue.	Miles of Mains.	Taps.	Hy-dr'ts.	Me-ters.
Missouri	534,896	(1) 26	21,452,561	1,667,459	645	53,888	5,786	3,240
Arkansas	31,424	10	1,119,767	106 495	64	2,974	482	88
Texas	166 407	51	5,367,300	689 095	465	17,815	3,086	911
Colorado	90,188	(1) 40	3,717,829	415 204	270	13,443	1,505	174
New Mexico	20,556	7	627,000	59,580	54	1,636	183	12
Total So. W'n	843,471	(2) 134	32,284,457	2,987,833	1,498	89,756	10 992	4,425

TABLE 4-H.—PACIFIC GROUP.

STATE.	Pop'n on Water-Works 1880 census.	No. of works.	Cost.	Revenue.	Miles of Mains.	Taps.	Hy-dr'ts.	Me-ters.
Washington	10,395	8	573,600	65,800	66	2,040	228	37
Oregon	34,764	17	983,000	181,500	115	5,362	279	54
California	436,608	(2) 78	31,556,897	2,863,141	1,561	71,732	3,906	9,784
Arizona	9,816	4	665,000	52,500	19	1,555	103	48
Nevada	30,689	11	4,082,740	35[illegible],260	127	4,195	267	20
Utah	13,769	4	541,000	48 648	43	2,697	232	1
Idaho	....	4	48,000	10,920	11	345	32	1
Total Pacific	536,041	(2) 126	38,450,237	3,575,759	1,942	87,926	5,047	9,945
Total Far W'n	2,051,545	490	93,331,426	8,668,237	4,878	232,220	27,450	17,817
Total Eastern	12,806,067	1,176	338,894,120	30,688,024	19,379	1,656,524	141,061	89,443
Total U. S	14,857,612	1,666	432,225,546	39,363,281	24,257	2,089,544	168,511	107,260

This makes a total of 153 works now known to be projected, or about 9.3 per cent. of the existing works, the two Southeasterly groups showing the most progress in this respect, having works numbering 31.2 per cent. of its existing works projected. The three far west groups together have only 10 per cent.

It will be seen from Tables 1 and 2 that before 1861 there were only 9 water-works in this whole region, 7 of them in California; and even up to 1871 there were only 31. The remaining 459 have all been built since, and all but 73 of them (or 386) since 1880. Thus only 104 water-works existed prior to 1881, while 386 have been built in the years 1881-8 inclusive.

TABLE 5-F-G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES WATER-WORKS. — SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES WATER-WORKS, AS GIVEN IN TABLE 3-F-G-H.

NORTHWESTERN STATES.

DATE.	Present pop'n of water-works.	No. of works.	Present Finances.		Miles of Main.	Number of		
			Cost.	Revenue.		Taps.	Hydrants.	Meters.
1867-70	91,046	3	3,406,651	345,674	221	11,805	2,302	477
1871-80	211,059	(1) 13	5,358,500	518,266	273	14,220	2,271	1,430
1881-85	243,911	79	9,448,887	888,626	546	21,088	3,822	1,459
1886-88	116,365	124	4,182,694	339,779	379	7,952	2,897	80
Unk'wn	9,652	8	200,000	12,300	19	473	119	1
Totals.	672,033	(1) 227	22,596,732	2,104,645	1,438	55,538	11,411	3,447
SOUTHWESTERN STATES.								
18 0-50	350,518	1	13,000,000	920,000	315	34,022	3,197	2 143
1851-60	....	....	....	....	....	....	....	......
1861-70	....	....	....	....	....	....	....	......
1871-80	267,915	21	10,456,000	1,210,239	482	33,721	3,392	1,360
1881-85	142,395	55	5,465,036	511,264	412	15,847	2,271	763
1886-89	77,661	(1) 54	3,279,421	336,530	282	6,016	2,055	159
Unk'wn	4,982	(1) 3	84,000	9,800	7	150	77	......
Totals.	843,471	(2) 134	32,284,457	2,987,833	1,498	89,756	10,992	4,425
PACIFIC STATES.								
1821-50	25,060	2	450,000	143,000	46	5,260	387	......
1851-60	263,310	6	17,653,000	1,498,800	285	28,845	1,595	8,542
1861-70	94,955	19	7,292,800	725,103	513	21,170	722	396
1871-80	90,772	(2) 36	7,408,145	750,816	537	21,331	1,297	871
1881-85	37,827	23	2,608,879	282,400	311	6,917	407	114
1886-89	14,092	36	2,914,413	159,640	240	4,060	568	22
Unk'wn	10,025	4	128,000	16,000	10	340	71	......
Totals.	536,041	(2) 126	38,450,237	3,575,759	1,942	87,926	5,047	9,945
GRAND TOTALS, NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES.								
1821-50	375,578	3	13,450,000	1,063,000	361	39,282	3,584	2,143
1851-60	263,310	6	17,653,000	1,498,800	285	28 845	1,595	8,542
1861-70	186,001	22	10,699,451	1,070,777	734	32,975	3,024	873
1871-80	5 9,746	(3) 70	23,222,645	2,479,321	1,292	69,275	6,960	3,661
1881-85	424,133	157	17,517,802	1,682,290	1,269	43,852	6,500	2,336
1886-89	208,118	(1) 214	10,376,528	835,949	901	18,028	5,520	261
Unk'wn	24 659	(1) 15	412,000	38,100	36	963	267	1
Totals.	2,051,545	(5) 485	93,331,426	8,668,237	4,878	233,220	27,450	17,817

Table 6 gives the population statistics, which mostly explain themselves. The necessity of using census records which are already nine years old for a rapidly growing section like this is very unfortunate, but as the ratio of growth between 1870 and 1880 is given for each State and group the evil is minimized. The "population on water-works" being likewise that of 1880, the ratio of it to total city population should remain about the same, however, and the very large ratio which appears in the far west (129.2 per cent, against

113.0 per cent. east of the Mississippi) is rather an evidence of superior enterprise than of defective census records.

TABLE 6—F-G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.]

STATES.	Total Population.			Urban Populati'n 1880.	Per cent. of total.	Popula'n on Water-works, 1888.		
	1870	1880	Inc. per cent.			Total by 1880 Census.	P. C. of Total pop'n.	P. C. of Urban pop'n.
TABLE 6 F. NORTHWESTERN GROUP.								
Iowa	1,194,020	1,624,615	36.0	201,200	12.4	262,396	16.2	129.5
Minnesota	439,706	780,773	77.5	129,567	16.6	147,866	18.9	114.2
Kansas	364,399	996,096	173.3	84,907	8.5	129,916	13.1	153.3
Nebraska	122,993	452,402	267.8	51,879	11.5	89,850	19.9	173.4
Dakota	14,181	135,177	853.2	......	......	23,723	17.5	.....
Wyoming	9,118	20,789	127.9	......	.....	8,695	41.7	.....
Montana	20,595	39,159	90.1	......	......	9,587	24.5	.....
Total N. W.	2,165,012	4,049,011	87.1	468,153	11.5	672,033	16.6	143.5
TABLE 6-G. SOUTHWESTERN GROUP.								
Missouri	1,721,295	2,168,380	25.9	505,903	23.3	534,896	24.7	106.0
Arkansas	484,471	802,525	65.6	13,138	91.6	31,424	3.9	240.0
Texas	818,579	1,591,749	94.4	115,396	7.2	166,407	10.5	144.0
Colorado	39,864	194,327	387.4	59,715	30.7	90,188	46.3	151.2
New Mexico	91,874	119,565	30.1	6,635	5.5	20,556	17.2	310.0
Total S. W.	3,156,083	4,876,346	54.5	700,787	14.4	843,471	17.3	120.4
TABLE 6-H. PACIFIC GROUP.								
Washington	23,955	75,116	213.5	......	......	10,395	13.8	.....
Oregon	90,923	174,768	92.2	17,577	10.0	34,764	19.8	197.5
California	560,247	864,694	54.3	344,004	39.8	436,008	50.5	127.0
Arizona	9,658	40,440	318.7	7,037	17.4	9,816	24.3	140.2
Nevada	42,491	62,266	46.5	23,884	38.4	30,689	49.2	128.4
Utah	86,786	143,963	65.8	26,837	18.6	13,769	9.6	51.2
Idaho	14,999	32,610	117.4	......	......	......	......	.....
Total Pacific	829,059	1,393,857	68.2	419,309	30.1	536,041	38.4	127.8
Total Far West	6,150,154	10,319,414	67.7	1,588,249	15.4	2,051,545	19.9	129.2
Total Eastern	32,408,217	39,836,369	23.2	11,347,861	28.4	12,806,067	32.1	113.0
Total U. S	38,558,371	50,155,783	30.1	12,936,110	25.7	14,857,612	29.6	115.0

Discussion of Table 7, showing the classifications of water-works by size of towns, we postpone until we summarize the works of the whole United States.

Table 8 shows the cost per head supplied of water-works to be very high in the far west, a fact in part due, undoubtedly, to more rapid growth of population since the census, but only in part: for there is no doubt that the western investments are proportionately greater than in the east. The cost per mile of main is more trustworthy, and likewise more uniform. In the northwest it averages

$15,660, in the southwest $21,580 (largely because of the enormous cost of the St. Louis water-works, $13,000,000 or $41,220 per mile of main this one work aggregating 40.3 per cent. of the total southwest investment); in the Pacific group $19,800, and in the whole far west $19,150, against $17,500 in the eastern United States.

TABLE 7—F-G-H.

NORTHWESTERN, SOUTHWESTERN AND PACIFIC STATES.—CLASSIFICATION OF WATER-WORKS BY SIZE OF TOWN IN 1880.

STATES.	1,000 or under.	1,000 to 3,000.	3,000 to 5,000.	5,000 to 10,000.	10,000 to 20,000.	20,000 or over.	Total No.
Iowa	10	19	10	7	4	3	53
Minnesota	4	7	1	5	1	2	20
Kansas	29	32	5	2	3	....	71
Nebraska	25	14	2	....	1	1	43
Dakota	19	5	2	....	....	....	26
Wyoming	2	2	1	....	....	....	5
Montana	5	....	2	....	....	....	7
Total N. W.	94	79	23	14	9	6	225
Missouri	1	7	8	6	1	3	26
Arkansas	2	3	4	....	1	....	10
Texas	18	16	7	4	3	2	50
Colorado	25	10	4	....	1	1	41
New Mexico	1	4	2	....	....	....	7
Total S. W	47	40	25	10	6	6	134
Washington	4	2	2	....	....	....	8
Oregon	9	7	....	....	1	....	17
California	27	33	7	3	2	3	75
Arizonia	2	1	....	1	....	....	4
Nevada	6	2	2	....	1	....	11
Utah	....	1	1	1	....	1	4
Idaho	4	....	....	....	....	....	4
Total Pac	52	46	12	5	4	4	123
Tot'l Far West'n	193	165	60	29	19	16	482
Total Eastern	143	395	225	215	106	83	1,167
Total U. S	336	560	285	244	125	99	1.649

The cost per tap also ranges high in the far west, being $406 in the northwest, $359 in the southwest, and $438 in the Pacific group, averaging $401, against $184 in the rest of theUnited States. The revenue per tap varies but little from the average of $37.30 in either group(being $40.70 on the Pacific coast) but is very high in comparison with the eastern United States, which averages only $16.60. The revenue per mile of main, however, is singularly uniform throughout the country, being $1,778 in the three far-western groups,against $1,583 in the rest of the country, indicating that the higher revenue per tap is a necessity because of fewer taps per mile of main.

The per cent. of revenue (gross) to cost is very remarkably uniform in the three far west groups at 9.30 per cent. against 9.06 per cent. in the rest of the United States. Considering the great difference west separately. The aggregates for each of the three groups are shown in Table 15-S, to follow, in the summary for the whole United States.

TABLE 10 F G H.

NORTHWESTEEN, SOUTHWESTERN AND PACIFIC STATES WATER WORKS—SOURCES OF SUPPLY.

[Some works have a double source of supply, which increases the total for some States.]

STATE.	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Iowa	3	3*	....	14	....	2	29	4	55
Minnesota........	....	2	....	8	4	1	5	....	20
Kansas.........	3	2	....	18	....	6	39	6	74
Nebraska.......	1	....	....	9	....	2	28	6	46
Dakota	....	3	....	8	2	1	11	1	26
Wyoming.......	....	1	....	2	....	1	....	1	5
Montana........	....	....	1	3	....	1	1	1	7
Total No. W'n..	7	11	1	62	6	14	113	19	233
Per cent	3.0	4.7	0.4	26.6	2.6	6.0	48.5	8.2	100.0

* Dubuque draws water from an abandoned mining tunnel, classed as spring.

STATE.	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Missouri	2	1	....	23	....	1	3	....	30
Arkansas.	....	2	....	6	....	....	3	....	11
Texas........	1	8	....	23	1	8	20	1	57
Colorado........	3	4	2	12	1	12	5	1	40
New Mexico....	1	2	....	2	....	....	4	....	9
Total So. W'n..	7	17	2	66	2	16	35	2	147
Per cent	4.8	11.5	1.4	44.8	1.4	10.9	23.8	1.4	100.0

STATE.	S'rface	Sp'ngs	Brook	River	Lake	Creek	Wells	Unk'n	T'tal
Washington....	....	3	....	1	1	2	....	1	8
Oregon.	....	4	....	9	....	1	2	1	17
California	3†	14*	5	22	3	11	26	1	85
Arizona...	1	....	....	1	....	1	1	....	4
Nevada	....	5*	1	2	....	2	....	1	11
Utah	....	....	1	2	....	1	....	....	4
Idaho	....	1	1	1	....	1	....	....	4
Total Pacific...	4	27	8	38	4	19	29	4	133
Per cent	3.0	20.3	6.0	28.6	3.0	14.3	21.8	3.0	100.0
Total Far West.	18	55	11	166	12	49	177	25	513
" Eastern..	84	208	92	250	138	87	244	27	1,130
Per cent. West.	3.5	10.7	2.1	32.4	2.3	9.6	34.5	4.9	100.0
" East..	7.4	18.4	8.2	22.1	12.2	7.7	21.6	2.4	100.0

* Two of these works in California, and 1 in Nevada, classed under springs, draw water from abandoned mining tunnels.

† Two of these supplied from canals.

Table 16 shows the total of pumping capacity, in part by States, and in part (when the States or Territories had but few works in each) by groups of States. The contracts, as in former groups, are in some cases notable and curious; as for instance, that there should be nearly three times as many Holly pumps as Worthington in Nebraska, Dakota and Wyoming, while there are over twice as many Worthingtons as Hollys in Arkansas and Texas. The reasons for these differences, however, and the moral to be drawn from them, we leave everyone interested to study out for themselves. As in other groups the total of "Miscellaneous" is very large, consisting chiefly

TABLE 13 F-G-H.

OWNERSHIP OF FAR WESTERN WATER WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

Table 13-F. NORTHWESTERN.	Iowa.	Minn.	Kan.	Neb.	Dak.	Wyo.	Mont.	Total N. W.
City or town	33	11	29	32	19	2	2	128
Local company	19	8	34	7	5	3	5	81
Outside company	1	1	5	3	1	....	....	11
Individuals	....	....	4	1	1	....	....	6
Unknown	....	....	....	....	....	....	....	....
Total Number.	53	20	72	43	26	5	7	226
Population supplied by public works	69,651	115,967	35,488	33,163	11.685	4,907	1,160	271,961
P. C. of pop'n supp'd by city works	26.5	78.5	27.3	36.9	49.2	56.5	11.5	40.5
Pop'n on private w'ks	192,745	31,899	94,428	56.687	12,098	3,788	8,487	400,072
Pop'n per private w'k.	38,549	3,544	2,190	5,153	1,720	1,263	1,697	4,080
P. C. of census city pop'n supplied by public works	34.5	89.6	42.4	63.9	....	....	....	58.1

Table 13-G. SOUTHWESTERN.	Mo.	Ark.	Tex.	Col.	N. M.	Total S. W.	Total N. W., S. W., Pac.
City or town..............	3	1	20	22	1	47	194
Local company	24	9	27	18	6	84	258
Outside company..........	....	....	1	....	....	1	12
Individuals	....	....	3	....	....	3	25
Unknown	....	....	....	1	....	1	1
Total Number..........	27	10	51	41	7	136	490
Population supplied by public works............	352,927	1,233	50.613	30,798	1,272	437.023	778.164
P. C. of pop'n supplied by city works	66.0	3.9	30.4	33.7	6.3	51.8	37.9
Pop'n on private works..	181,969	30,191	115,794	59,210	19,284	406.448	1,273,381
Pop'n per private work. ..	7,580	3,355	3,730	3,120	3,214	4,564	4,280
P. C. of census city pop'n supplied by public w'ks.	69.7	9.4	43.9	52.0	19.2	62.4	48.9

Table 13-H. PACIFIC.	Wash.	Ore.	Cal.	Ariz.	Nev.	Utah.	Idaho.	Total Pacific.
City or town	2	7	6	1	....	3	....	19
Local company	6	9	62	2	9	1	4	93
Outside company ...	....	....	....	....	....	....	....	....
Individuals	....	1	12	1	2	....	....	16
Unknown	....	....	....	....	....	....	....	....
Total Number. ...	8	17	80	4	11	4	4	128
Population supplied by public works. ..	350	20.681	31,136	1.836	....	12.227	....	69.180
P. C. of pop'n supp'd by city works	0.3	53.2	7.8	18.7	... .	88.8	....	12.9
Pop'n on private w'ks	10,046	14,183	402,472	7,980	30,689	1.542	......	466.861
Pop'n per private w'k.	1,674	1,413	5,485	2,660	2,790	1,542	....	4,280
P. C. of census city pop'n supplied by public works	....	11.7	9.9	26.2	....	45.7	....	16.5

of a comparatively small number of very heavy special pumps at the larger works.

TABLE 14—F-G-H.

FAR WESTERN WATER-WORKS REPORTING OVER 100 METERS IN USE.

NORTHWEST GROUP.	
Des Moines, Ia.	1,000
21 others	421
(31 without meters)	1,421
Minneapolis, Minn.	228
St. Paul, "	243
7 others	101
(11 without meters)	578
Leavenworth, Kan	310
24 others	203
(47 without meters)	513
Omaha, Neb	400
5 others	68
(37 without meters)	468
Fargo, Dak	160
5 others	307
(20 without meters)	467

SUMMARY.	Wks.	Met.
Over 100 m	6	2347
Under 100 m	62	1100
No meters	158	....
	226	3447

SOUTHWEST GROUP.	
St. Louis, Mo	2,148
Kansas City, Mo	950
15 others	147
(10 without meters)	3,240
Ark., 5 small works	88
El Paso, Tex	400
Gainesville, Tex	103
15 others	408
(34 without meters)	911
Trinidad, Col	125
8 others	49
(32 without meters)	174
N. Mex., 3 miles	12

SUMMARY.	Wks.	Met.
Over 100 met	5	3721
Under 100 met.	46	704
No meters	85	....
	136	4425

PACIFIC GROUP.	
Wash., 3 works	37
Oregon, 3 works	54
San Francisco, Cal	8,500
Los Angeles, Cal	150
Oakland, Cal	150
San Diego, Cal	245
Alameda, Cal	550
17 others	189
(58 without meters)	9,784
Ariz., 2 works	58
Nev., 1 work	20

SUMMARY.	Wks.	Met.
Over 100 met.	5	9593
Under 100 met	20	350
No meters	103	....
	128	9945

WORKS HAVING OVER ONE-SIXTH OF THEIR TAPS METERED.

Towns	p. c. metered
Des Moines, Ia	40.0
Moorhead, Minn	21.7
Red Wing, "	22.1
Leavenworth, Kan	27.4
Owego, Kan	60.0
Fargo, Dak	38.7
Pierre, Dak	22.5

Towns.	p. c. metered.
Maryville, Mo	22.5
Hot Springs, Ark	20.0
Newport, Ark	28.3
El Paso, Tex	50.0
Gainesville Tex	25.8
Leadville, Col	27.8

Towns.	p. c. metered.
Calvert, Tex	25 0
San Francisco, Cal	32.7
Menlo Park, Cal	25.2
San Diego, Cal.	17.5
Alameda, Cal.	55.0
Prescott, Ariz.	17.6

TABLE 16—F-G-H.

FAR WESTERN WATER-WORKS.—PUMPING CAPACITY IN MILLIONS OF GALLONS PER DAY.

Makes of Pumps arranged alphabetically.	Northwestern Group.					Southwestern Group.				Pa'f'c	Total Far West.
	Iowa.	Minn.	Kans.	Neb., etc.	Total N. W.	Mo.	Ark. & Tex.	Col. & N. M.	Total S. W.	Total Pacific	
Blake	9.6	7.3	5.8	7.8	30.5	9.8	14.1	2.0	5.5	3.0	59.4
Buffalo	......	......	7.6	3.0	10.6	......	5.5	......	....	......	16.1
Cameron	0.1	......	......	......	0.1	......	......	1.0	1.0	1.0	2.1
Deane	2.2	3.0	21.1	10.0	36.3	12.0	4.3	0.8	17.1	......	53.4
Dow	......	......	......	......	......	......	......	......	......	8.4	8.4
Gordon & Maxwell.	12.6	......	5.0	2.5	20.1	......	3.8	2.0	5.8	......	25.9
Holly-Gaskill	26.8	1.0	23.3	27.5	78.6	32.3	18.5	9.3	60.1	12.8	151.5
Hooker	......	......	......	......	......	......	......	......	16.0	8.7	8.7
Knowles	15.1	1.5	0.8	18.8	36.2	1.5	10.3	4.2	13.2	5.3	57.5
Smith & Vaile	0.3	......	5.5	1.8	7.6	3.4	9.8	......	2.0	......	20.8
Walker	......	......	......	......	......	2.0	......	......	......	......	2.0
Worthington	13.3	17.2	15.5	9.3	55.3	38.3	41.8	2.8	82.9	32.3	170.5
Miscellaneous	13.0	80.8	7.0	32.7	133.5	121.5	7.2	8.1	136.8	21.8	292.1
	93.0	110.8	91.6	113.4	408.8	220.8	115.3	30.2	366.3	93.3	868.4

THE WATER-WORKS OF THE UNITED STATES AND CANADA.

The summaries for the whole United States of the statistics which have been so far given for the various groups of States separately appear in the following tables and are in a sense the most interesting of all. To facilitate comparison and save space, the statistics for Canada

TABLE 1—S.

UNITED STATES AND CANADIAN WATER-WORKS.—SUMMARY OF DATES OF CONSTRUCTION BY GROUPS OF STATES.

[Date of completion taken when construction extended over more than one year.]

YEAR.	Water-Works Built.									
	N. E.	Mid.	So. Atl.	So. C.	No. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
Before 1800	1	3	1	......	......	......	......	......	5	......
1800 10	2	6	......	......	......	......	......	......	8	1
1811-20	2	1	......	......	1	......	......	......	4	......
1821-30	1	5	3	1	1	......	1	1	13	......
1831-40	3	3	3	6	3	......	......	1	19	1
1841-50	3	12	1	1	2	......	......	......	19	4
1851	1	3	......	......	......	......	......	......	4	......
1852	1	4	......	......	......	......	......	......	5	......
1853	......	2	......	......	......	......	......	2	4	1
1854	(1) 2	3	1	......	......	......	......	......	(1) 6	......
1855	4	2	......	......	......	......	......	......	6	......
1856	1	3	1	......	1	......	......	......	6	1
1857	2	(1) 5	......	......	......	......	......	1	(1) 8	......
1858	......	2	2	......	......	......	......	1	5	......
1859	1	5	......	......	......	......	......	2	8	1
1860	(1) 2	4	......	1	2	......	......	......	(1) 9	1
1861	1	2	......	......	......	......	......	1	4	......
1862	3	......	......	......	1	......	......	3	7	......
1863	......	......	......	......	......	......	......	......	......	1
1864	1	1	......	1	......	......	......	1	4	......
1865	1	2	......	......	......	......	......	5	8	......
1866	1	3	......	......	1	......	......	2	7	......
1867	(1) 2	5	......	1	......	1	......	1	(1) 10	......
1868	(1) 4	6	......	1	1	......	......	2	(1) 14	......
1869	(1) 9	4	......	......	5	......	......	2	(1) 20	......
1870	(3) 4	10	......	1	9	2	......	2	(3) 28	1
1871	(1) 2	16	1	......	5	2	1	7	(1) 34	......
1872	7	12	1	2	8	......	1	1	32	1
1873	14	12	1	2	13	......	1	4	47	3
1874	7	(1) 12	1	......	9	2	1	5	(1) 37	2
1875	8	(2) 13	2	......	9	2	3	4	(2) 41	2
1876	(1) 10	(1) 12	2	1	11	(1) 5	1	5	(3) 47	3
1877	3	(1) 4	1	......	4	1	......	(1) 2	(2) 15	1
1878	(1) 6	11	2	......	(1) 4	4	2	(1) 2	(3) 31	2
1879	(1) 8	13	......	2	10	3	6	(1) 1	(2) 43	2
1880	(1) 6	8	2	1	6	4	5	5	(1) 39	(1) 2
1881	(1) 8	10	2	1	7	6	4	2	(1) 40	2
1882	(3) 9	(6) 14	4	......	(1) 22	13	9	8	(10) 79	4
1883	(1) 9	(3) 22	2	2	15	19	14	4	(4) 87	4
1884	(1) 21	(3) 23	1	1	18	20	16	6	(4) 106	(1) 4
1885	(3) 16	(1) 24	5	1	24	9	12	3	(4) 94	......
1886	(2) 16	(2) 28	7	6	(1) 35	22	11	5	(5) 130	4
1887	(6) 24	(1) 33	8	4	(1) 32	39	14	10	(8) 164	6
1888	(2) 20	(3) 28	17	18	64	62	(1) 29	21	(6) 259	(1) 11
Unknown.	8	(2) 15	2	1	2	8	4	4	(2) 44	3
Total	(32) 251	(27) 406	73	55	(4) 325	(1) 224	(1) 135	(3) 126	(68) 1598	(8) 63

Subsidiary water-works, viz.: those which derive their supply from the mains of some other adjacent works, but are otherwise independent systems are enumerated above in parentheses. There are but 4 in the North Central States.

Canada in this and the following tables includes 3 Newfoundland Works.

have been given in the same tables after the totals for the United States. In comparing them it needs to be remembered that the population of Canada was only 9.4 per cent. of that of the United States in 1870, 8.6 per cent in 1880, and is probably now not over 7.7 per cent. as much, or 5 million against 65 million, if indeed so much. Moreover, the urban population, in towns of over 4,000 inhabitants, was only 0.72 against 12.94 millions, or 5.6 per cent. as much.

Tables 1 and 2 show that the total number of works in Canada (excluding 3 in Newfoundland) is 68, against 1,666 in the United States, or 4.75 per cent., the total capital invested being 21 against 432 millions, or 4.95 per cent., and the miles of mains (Table 4) 5.65 per cent. This and other data given, shows that Canada is somewhat behind the average of the United States in its water supply conditions, but not materially.

TABLE 2-S.

UNITED STATES AND CANADIAN WATER-WORKS — SUMMARY OF CONSTRUCTION BY STATES AND HALF DECADES.

[Date given is that of completion of works.]

DATE.	N. E.	Mid.	So.A.	So.C.	No. C.	N. W.	S. W.	Pac.	Total U. S.	Canada.
Before 1880	1	3	1	......	....	....	....	....	5	....
1801-10	2	6	......	......	....	....	....	....	8	1
1811-20	2	1	......	......	1	....	....	....	4	....
1821-30	1	5	3	1	1	....	1	1	13	....
1831-40	3	3	3	6	3	....	....	1	19	1
1841-50	3	12	1	1	2	....	....	....	19	4
1851-55	(1) 8	14	1	......	....	....	....	2	(1) 25	1
1856-60	(1) 6	(1) 19	3	1	3	....	....	4	(2) 38	3
1861-65	6	5	.....	1	1	....	....	10	23	1
1866-70	(6) 20	28	......	3	16	3	....	9	(6) 79	1
1871-75	(1) 38	(3) 65	6	4	44	6	7	21	(4) 191	8
1876-80	(4) 33	(2) 48	7	4	(1) 35	(1) 17	14	(3) 15	(11) 173	(1) 10
1881-85	(9) 63	(13) 93	14	5	(1) 86	67	55	23	(23) 406	(1) 14
1886-88	(10) 60	(6) 98	32	28	(2) 131	123	(1) 54	6	(19) 553	(1) 21
Unknown.	8	(2) 15	2	1	2	8	4	4	(2) 44	3
Total.	(32) 254	(27) 406	73	55	(4) 325	(1) 224	(1) 135	(3) 126	(68) 1698	(3) 68

The number of water-works at the end of each decennial period may be summarized from Tables 1 and 2 as follows:

	N. E	Mid.	No. C.	E. of Miss. Riv.	W. of Miss. Riv.	Total U. S.	Canada
1800	1	3	—	5	—	5	—
1810	3	9	—	13	—	13	1
1820	5	10	1	17	—	17	1
1830	6	15	2	29	2	31	1
1840	9	18	5	46	3	49	2
1850	12	30	7	65	3	68	6
1860	28	64	10	123	9	132	10
1870	60	97	27	209	31	240	12
1880	136	215	107	514	115	629	31
1888	286	433	329	1,176	490	1,666	71
P. C. inc. fr. 1880.	111	101	208	129	326	165	129

Nothing except a diagram (which will shortly appear in the columns of ENGINEERING NEWS) could more vividly set forth than these figures the enormous recent growth of water-works as compared with past progress. It hardly admits of doubt that by 1890 there will be over 2,000 water-works in the United States, more than two-thirds of which will have been built since 1880, and *all but* 240 of which will have been built since 1870, when we were in the habit of looking on this country as pretty well advanced in all such matters. The retarding effect of the war is very evident in Tables 1 and 2, only 23 works in all having been built in 1861-5, and only 79 in 1866-70. Singularly enough, only two water-works were built in Canada during this period, although Canada suffered little directly and profited much from our war.

The total number of water-works in Canada is so small that it has not seemed worth while to summarize the water-works for each province separately, further than is done in Table 4 and 5 I-J at the end of this article. The total number of works in each province at various dates was:

	Total No. water-works at end of					
	1850	1860	1870	1880	1885	1888
In Ontario	2	4	5	14	21	35
Quebec	1	2	2	10	12	16
Manitoba	—	—	—	—	1	1
British Columbia	—	—	—	—	—	2
New Brunswick	1	2	2	3	5	6
Nova Scotia	1	1	1	2	4	7
Prince Edward's Island	—	—	—	—	—	1
Total Dominion of Canada	5	9	10	29	43	68
Newfoundland	1	1	2	2	3	3

It will be seen that Ontario has more than half the water-works of Canada, but it has likewise 45 per cent. of the population.

TABLE 4-S.

UNITED STATES AND CANADIAN WATER WORKS — SUMMARY BY STATES OF THE MAIN STATISTICS GIVEN IN TABLE 3-E.

Group.	Pop'n on Water-Works 1880 census.	No. of works.		Present Finances.		Miles of Mains.	Number of		
				Cost.	Revenue.		Taps.	Hy-drants.	Meters
New England	2,409,359	(32)	254	84,902,725	6,412,624	5,291	315,404	32,300	37,913
Middle	6,165,618	(27	406	156,522,264	15,025,661	7,428	890,021	56,095	34,346
So. Atlantic	533,069		73	9,784,982	1,018,582	747	48,334	5,249	2,889
So. Central	684,289		55	18,133,721	1,472,538	876	50,302	6,871	2,365
No. Central	3,010,732	(4)	325	69,460,428	6,758,619	5,037	352,463	40,546	12,085
Northw'n	672,033	(1)	225	22,596,732	2,104,645	1,438	55,538	11,411	3,447
Southw'n.	843,471	(2)	134	32,284,457	2,987,833	1,498	89,756	10,992	4,425
Pacific	536,041	(2)	126	38,450,237	3,575,759	1.942	87,926	5,047	9,945
Total U. S	14,857,612	(68)	1598	432,225,546	39,363,281	24.257	2089,544	168,511	107,415
Canada.	737,043	(3)	68	21,313,809	1,955,069	1,371	172,947	9,314	2,077

Table 4-S shows that the present aggregate of capital invested in the 1,666 water-works of the United States is the enormous sum of $432,225,546, or about $6.65 for every man, woman and child in it. Large as this sum is, however, it is only 1 per cent. of the estimated total wealth of the United States in 1880 (43,642 millions) and not much over one-half of one per cent. now. Still, it represents nearly one-tenth as great a capital as that actually invested in railways, which was in 1883, according to Poor's manual:

Stock	$4,191,562,029
Debt	$4,186,943,116
Against water-works cost	432,225,546

The water-works cost is nearly all the actual cash expenditure, whereas the actual cash paid out for railway construction and equipment is little if any more than half the aggregate of stock and bonds.

In miles of main we have:

Water-works mains	24,257 miles.
Railways	149,913 "

Or but little more than six times as many miles of railway as miles of main. Considering that these water mains are all concentrated on the small area of cities, and considering the enormous distances between cities of railway lines, this is a remarkable contrast.

TABLE 5-S.

UNITED STATES WATER WORKS.—SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL UNITED STATES WATER-WORKS.

DATE.	Present pop'n of water-works.	No. of works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
1798–1850	5,445,846	69	148,832,872	13,246,050	5,213.64	833,106	46,257	31,873
51–60	2,318,648	(3) 61	75,569,799	6,833.464	3,027.21	302.836	19,970	23,509
61–70	1,252,081	(6) 102	35,403,314	3,477,131	2,670.93	163,783	15,712	4,752
71–80	2,881,478	(13) 354	88,932,463	7,890,267	5,962.02	345,157	37,745	37,268
81–85	1,640,049	(22) 418	43,586,712	4,195,560	3,861.35	159,978	24.770	8,342
86–88	1,260,032	(16) 565	39,358,886	3,645,699	3,447.73	80,615	23,565	1,514
Unknown	59,478	(4) 34	641,500	68,090	73.80	3,269	492	12
Total.	14,857,612	(64) 1603	432,225,546	39,356,261	24,256.68	1,888,744	168,511	107,260

N. B.—This table does *not* represent the status of the works at the several dates (except as to number) but the statistics of the *current year* 1888, of works *first opened* at the several dates.

The population statistics given in Table 6 will be interesting in themselves, as similar records for the groups of the United States have never been made up before. The increase of total population per cent. of the three Northeastern groups (New England, Middle, North Central) will be seen to have been very small between 1870 and 1880 (15 to 23 per cent.) against a very large growth (27.2 and 31.6 per cent.) in the two Southeastern groups. This was explained at the time as due largely to defects of omission in the 1870 census, but still it is notable that even in 1870-80, the North Central group was sending out emigrants rather than receiving immigrants. This appears clear

TABLE 6—S.

UNITED STATES AND CANADA.—POPULATION STATISTICS IN RESPECT TO WATER-WORKS.

[The "town population" is in towns of 4,000 inhabitants or over.]

STATES.	Total Population.			Urban Popu't'n 1880.	Per cent. of total.	Pop'n on Water-works, 1888.			Av. pop'n on each water-works.
						Total by 1880 Census.	P. C. of		
	1870	1880	Inc. per cent.				Total pop'n.	Urban pop'n.	
New England	3,487,924	4,010,529	15.0	,989,339	49.6	2,409,359	59.8	120.6	8,391
Middle..........	9,848,415	11,756,053	19.4	,538,720	47.2	6,165,618	52.5	113.1	14,220
So. Atlantic	4,816,001	6.338,022	31.6	475,660	7.5	536,069	8.5	112.7	7,330
So. Central.......	6,131,360	6,525,097	27.2	654,355	10.2	684,289	10.5	103.0	12,400
No. Central.......	9,124,517	11,206.668	22.8	2,689,787	24.0	3,010,732	26.9	111.9	9,140
Northwestern....	2,165,012	4,019.011	87.1	468.153	11.5	672,033	16.6	143.5	2 980
Southwestern....	3.156,083	4,876.546	54.5	700,787	14.4	843.471	17.3	120.4	6,190
Pacific	829,059	1,393 857	68.2	419,309	30.1	536,041	38.4	127.9	4.170
Total U. S.......	38,558,371	50,155,783	30.1	12,936,110	25.7	14,857,612	29.6	114.9	8.900
Canada	3,635,024	4,324,810	17.2	723.340	16.7	706,273	16.3	97.6	10,350
Newfoundland...	161,374	185,000	14.6	27,770	15.0	30,770	16.6	110.8	

The Canadian population is for 1871 and 1881, and the Newfoundland population for 1874 and 1883, the latter estimated.

from the fact that the natural rate of increase from births in the United States has been determined to be about 2 per cent. per annum, or 21.9 per cent. per decade, whereas the total increase of the North Central group was only 22.8 per cent., Wisconsin being still receiving many immigrants. The three far-west groups show very heavy rates of increase, and Canada, a very small one. As a matter of interest in this connection we may note that New Brunswick increased in population 12.5 per cent., Nova Scotia, 13.6, Quebec, 14.1, and Ontario, 18.6 per cent., the average of the Dominion being 17.2 per cent.

TABLE 7 S.

UNITED STATES AND CANADA — CLASSIFICATION CF WATER-WORKS BY SIZE OF TOWN IN 1880.

GROUP.	1,000 or under.	1,000 to 3,000	3,000 to 5,000	5,000 to 10,000	10,000 to 20,000	20,000 or over.	Total No.
New England	40	80	65	48	35	19	287
Middle..............	47	174	78	78	24	32	433
So. Atlantic	13	25	7	11	7	8	71
So. Central........	8	14	7	11	4	7	51
No. Central	35	102	68	67	36	17	325.
Northwestern....	94	79	23	14	9	6	225
Southwestern	47	40	25	10	6	6	134
Pacific	52	46	12	5	4	4	123
Total U. S	336	560	285	244	125	99	1,649
Canada	9	14	15	19	3	8	68

Table 7, showing sizes of towns supplied, may be abstracted by per centages as follows: The record showing that the proportion of works in small towns is rather below the average in Canada, and enormously above it in the far west (trans-Mississippi) region. The census records are over 8 years old, which partly explains the contrast as the far west has been growing very fast, but even allowing for this the proportion of small town works must be larger in that section than anywhere else.

	N. E.	Mid.	So.	No. C.	Far W.	Total U. S.	Canada.
Towns of 1,000 or under	13.9	10.9	17.2	10.8	40.0	20.3	13.3
" " 3,000 " "	41.8	51.0	49.1	42.2	74.4	54.2	33.9
" " 5,000 " "	64.3	69.0	60.6	63.0	86.8	71.6	55.9
" " 10,000 " "	81.2	87.0	78.6	83.8	92.8	86.3	83.9

As as average 97.6 per cent. of the Canadian census city population have water-works, while 114.9 per cent. of the corresponding U. S. population have them, the proportion being singularly uniform throughout the groups.

Table 8 shows that the cost of works per head runs pretty uniform at $18 to $35 in the various groups, the Pacific group showing abnormally high ($71.80) because the population has been growing very fast there since 1880. The same cause operates to increase the cost per head in all the groups, and the real cost for the whole United States is probably considerably under $25 per head potentially supplied, with a revenue per head of about $2.40, the actual revenue per head being $2.65 both in the United States and Canada.

The cost per mile of main shows even less variation, ranging from $13,070 to $21,580, averaging $17,800 against $15,560, in Canada. The revenue per mile of main is also tolerably uniform, being least

($1,203) in New England, greatest in the Southwest ($2,000), averaging $1,620 against $1,426 in Canada.

TABLE 8-S.

UNITED STATES AND CANADIAN WATER-WORKS.— COST AND REVENUE PER HEAD, TAP, MILE OF MAIN, ETC.

GROUP.	Cost per			Revenue per			Population on water works.		P. C. rev. to cost.
	head on water-works.	mile of main.	tap.	head on w'ter w'ks.	mile of main.	tap.	per tap.	per meter.	
New England	$35 30	$16,800	$269	$2.66	$1,203	$20.30	7.6	63.4	7.54
Middle..............	25.40	21,000	176	2.43	2,023	16.90	6.9	181	9.40
So. Atlantic.......	18.25	13,070	202	1.90	1,362	21.00	11.1	173	10.40
So. Central	26.50	20,650	360	2.15	1,678	29.20	13.4	289	8.13
No. Central..	23.10	13,780	197	2.24	1,328	19.18	8.5	250	9.72
Northwestern	33.60	15,660	406	3.13	1,461	37.90	12.1	195	9.31
Southwestern.....	38.25	21,580	359	3.55	2,000	33.25	9.4	190	9.29
Pacific	71.80	19,800	438	6.68	1,838	40.70	6.1	54	9.29
Total U. S	29.15	17,800	207	2.65	1,620	18.80	7.11	138½	9.11
Canada	28.90	15,560	123	2.65	1,426	11.30	4.26	354	9.16

The per cent. of revenue to cost is very extraordinarily uniform at a little over 9 per cent. both in the United States and Canada, the most marked exception being in New England, where it is only 7.54 per cent.

The cost and revenue per tap shows more variation, being very high in the far west, although the population per tap there, even by the 1880 census, is rather above the average of the United States. The population, cost and revenue per tap in Canada are all extraordinarily low, indicating strongly that there is some error in the reported number of taps in Canada. We have endeavored to locate this error if there be one in fact, yet without success. We leave the figures to speak for themselves therefore, until our next annual issue.

TABLE 9—S.

UNITED STATES AND CANADA WATER-WORKS—KIND OF WORKS.

GROUP.	Gravity.	Pumping to				Unkno'n	Total.	P. C. gravity works.
		Reservoir.	Tank.	Stand-Pipe.	Direct.			
New England ..	130	50	21	31	21	5	258	50.4
Middle...........	175	116	23	44	40	4	412	42.4
So. Atlantic....	12	18	19	13	10	2	74	16.2
So. Central	5	17	5	21	5	3	56	8.9
No. Central.....	16	46	51	72	141	5	331	4.8
Northwestern..	18	46	50	60	47	3	224	8.0
Southwestern..	29	27	25	41	21	1	144	20.1
Pacific..........	75	32	20	5	9	2	143	52.5
Total U. S......	460	352	214	287	294	25	1,632	28.2
Canada	24	9	5	4	30	....	72	33.3

Some of the works have a double system which increases the total. Several gravity works have small auxiliary pumping systems for special service which have been disregarded. Most of the pumping works pump direct in case of fire.

The statistics as to kinds of works, given in Table 9, are interesting not only in respect to the widely varying proportion of gravity works, but in respect to the curious contrast which they show in forms of pumping works. The percentages of pumping works of the various types in the several groups is as follows:

Per Cent. of Works pumping to	Reservoir.	Tank.	Stand-pipe.	Direct.	Total.
New England	40.6	17.1	25.2	17.1	100.0
Middle	49.8	14.1	18.9	17.2	100.0
Southern	32.4	22.2	31.5	13.9	100.0
North Central	14.8	16.5	24.2	45.5	100.0
Northwestern	22.7	24.6	29.5	23.2	100.0
Southwestern	23.7	21.9	36.0	18.4	100.0
Pacific	49.5	30.3	7.6	13.6	100.0
Total U. S.	30.7	18.6	25.0	25.7	100.0
Canada	18.8	10.4	8.3	62.5	100.0

Direct works are the leading type only in a single group, the North Central, and in Canada. Stand-pipes predominate over tanks in almost every group, but largely in none. The use or non-use of reservoirs largely depends on topography, so is less significant.

TABLE 10-S.

UNITED STATES AND CANADIAN WATER-WORKS.—SOURCES OF SUPPLY.

[Several works in each group have double sources of supply, increasing the totals by so much.]

GROUP.	S'rface	Spring	Brook.	River.	Lake.	Creek.	Wells.	Unk'n.	T'tal.
New England ..	36	45	42	36	70	....	20	9	258
Middle	34	103	44	89	18	61	38	4	411
So. Atlantic	2	18	3	18	6	6	19	2	74
So. Central.....	2	12	3	20	....	5	9	3	54
No. Central.....	10	30	....	87	44	15	138	9	33
Northwestern ..	7	11	1	62	6	14	113	19	233
Southwestern ..	7	17	2	66	2	16	35	2	147
Pacific	4	27	8	36	4	19	29	4	133
Total U. S	102	263	103	416	150	136	421	52	1,643
Canada.	4	12	2	31	14	5	1	1	70

PERCENTAGES.

New England ..	14.0	17.4	16.3	14.0	27.1	....	7.7	3.5	100.0
Middle.	8.3	25.1	10.7	21.6	4.4	14.8	14.1	1.0	100.0
So. Atlantic .. So. Central...	3.1	4.7	4.7	29.7	4.7	8.6	21.9	3.9	100.0
No. Central....	3.0	9.0	....	26.1	13.2	4.5	41.5	2.7	100.0
Northwestern.	3.0	4.7	0.4	26.6	2.6	6.0	48.5	8.2	100.0
Southwestern..	4.8	11.5	1.4	44.8	1.4	10.9	23.8	1.4	100.0
Pacific	3.0	20.3	6.0	28.6	3.0	14.3	21.8	3.0	100.0
Total U.S	6.1	16.1	6.1	25.4	9.1	8.3	25.7	3.2	100.0
Canada	5.7	17.1	3.0	44.3	20.0	7.1	1.4	1.4	100.0

Table 10, of sources of supply, explains itself. It will bear study by those interested, but demands no further comment than has been already given in reviewing the separate groups. The heavy excess of river and lake supply in Canada, however, and non-use of wells, is notable.

Tables 11 and 12, giving working and fire pressures, we likewise leave to speak for themselves. From them the tendency of practice in any group may be at once determined. The most common working pressure for the whole United States, and likewise about the average pressure, will be seen to be about 65 lbs., and the most common fire pressure by far, 100 to 109 lbs. Out of 1,327 works reporting their working pressures, only 642, or about half, report higher fire pressures.

TABLE 11-S.

UNITED STATES AND CANADIAN WATER-WORKS.—AVERAGE WORKING PRESSURES.

[Representing in some of the gravity works the mean pressure in the mains. In pumping works, however, and in most of the gravity works, the pressure is that at the pumps, or principal mains, and hence, considerably higher than the effective pressure.]

PRESSURE per sq. in.	No'w'n.	So'w'n.	Pacific.	Total Far W'n.	Total Eastern.	Total U. S.	Total Canada.
Under 20	2	1	....	3	13	16	....
20-29	11	3	11	25	35	60	2
30-39	9	6	14	28	94	122	5
40-49	46	25	22	93	177	270	15
50-59	20	13	6	39	120	159	6
60-69	39	24	12	75	129	204	11
70-79	15	6	14	35	123	158	6
80-89	14	13	13	40	86	126	9
90-99	4	6	4	14	61	75	2
100-109	9	4	3	16	31	47	2
110-119	3	3	....	6	22	28	2
120-129	2	1	....	3	24	27	1
130-139	....	1	....	1	4	5	....
140-149	2	....	1	3	2	5	....
150-159	....	2	4	6	8	14	....
160-169	1	1	....	2	2	4	....
170-179	1	1	1	3	4	7	....
Total Works reporting.	178	110	104	392	935	1,327	61

A few works report an ordinary pressure of 200 lbs., but as these are doubtful they have been omitted.

TABLE 12-S.

FIRE PRESSURES OF UNITED STATES AND CANADIAN WATER-WORKS, WHEN THE SAME ARE HIGHER THAN THE NORMAL WORKING PRESSURES.

[Nearly all the following are pumping works, but there are a few gravity works which are able to turn on a higher fire pressure from higher reservoirs.]

FIRE PRESSURES. lbs per sq. in.	N'w'n.	S'w'n.	Pacific.	Total Far W'n.	Total Eastern.	Total U. S.	Total Canada.
40-49	....	....	3	3	6	9	1
50-59	....	....	2	2	9	11	....
60-69	....	2	3	5	22	27	2
70-79	5	1	3	9	27	36	7
80-89	8	3	6	17	56	73	4
90-99	12	3	4	19	51	70	3
100-109	32	15	6	53	84	143	7
110-119	5	2	2	9	23	32	3
120-129	29	15	4	48	51	99	6
130-139	2	10	2	14	16	30	1
140-149	4	2	....	6	17	23	....
150-159	11	9	2	22	32	54	4
160-169	3	2	1	6	7	13	....
170-179	1	....	1	2	9	11	1
180-189	....	....	....	....	3	3	....
190-199	1	....	....	1	2	3	....
200	5	3	2	10	1	11	1
Total works reporting.	118	67	41	226	416	642	40

nearly all of them of course being pumping works, of which there are 1,147 in all in the United States.

TABLE 12-S [2].

AMOUNT OF INCREASE ABOVE NORMAL PRESSURE.

	Total N'w'n.	Total S'w'n.	Total Pacific.	Total Far W'n.	Total Eastern	Total U. S.	Total Canada
Under 20	2	1	6	9	50	59	4
20-29	5	1	9	15	42	57	7
30-39	11	11	5	27	40	67	11
40-49	24	7	5	35	71	106	2
50-59	18	5	5	28	53	81	4
60-69	12	13	1	36	57	93	3
70-79	9	13	2	24	41	68	1
80-89	6	3	3	12	27	29	6
90-99	9	5	1	15	6	21	1
100-109	4		1	10	11	21	....
110-119	4	....	1	5	3	8	....
120-129	1	....	1	2	9	11	....
130-139	2	....	....	2	3	5	....
140-149	1	1	....	2	....	2	....
150-159	....	1	1	2	....	2	....
160-169	1	1	....	2	....	2	1
Total works reporting.	118	67	41	226	416	642	40

Table 13, on ownership of works, shows that a fraction over two-thirds of all the water-works population is supplied by public works, and over three-fourths in Canada. In the far west the proportion of public ownership is very small. No less than 45 water-works are reported as controlled by "outside companies," or by the syndicates which have recently been formed and done much useful work in introducing water-works. As many as 74 United States and Canadian water-works are owned by individuals.

TABLE 14—S.

UNITED STATES AND CANADA WATER WORKS.—USE OF METERS.

	Over 100 Meters		Under 100 Met's		No Met's Report'd	No. of Works R port'g Meters.	Total Meters.
New England	31	36,111	99	1,802	157	130	37,913
Middle	23	3.,345	124	2,001	287	147	34,3.6
South Atlantic	4	2,655	17	234	52	21	2,889
South Central	5	2,073	19	292	31	24	2,365
North Central	16	10,360	80	1,445	233	96	12,065
Northwestern	6	2,347	62	1,100	158	68	3,447
Southwestern	5	3,721	46	704	85	50	4,425
Pacific	5	9,595	20	350	103	25	9,945
Total U. S	95	99,217	467	7,928	1 103	562	107 415
Canada	4	1,278	26	797	38	30	2,077

Table 14, on use of meters, shows that there are already 107,415 meters in use (with 2,077 more in Canada) or about 1-19 of the taps. From Table 8, it will be seen that in proportion to taps, meters are by far the most common in the Pacific and New England groups, and much less used in Canada than in any of our groups. But 99 works, however, report over 100,000 of these meters, leaving nearly 1,600

TABLE 13–S.

OWNERSHIP OF UNITED STATES AND CANADIAN WATER WORKS, WITH POPULATION SUPPLIED BY PUBLIC WORKS, ETC.

	New England	Middle.	So. Atl.	So. C.	No. C.	N. W.	S. W.	Pacific.	Total U. S.	Canada.
City or town	119	137	41	13	211	128	47	19	715	41
Local company	149	248	30	41	86	81	84	93	812	15
Outside company	9	1	1	....	19	11	1	....	42	3
Individuals	8	19	1	1	11	6	3	16	65	9
Unknown	2	3	....	....	2	....	1	....	8	....
Total No	287	408	73	55	329	226	136	128	1,642	68
Population supplied by public works	1,710,574	4,889,527	315,193	147,165	2,246,068	271,961	437,023	69,180	10,086,691	556,696
P. C. of population supplied by city works	72·3	78·3	64·4	21·5	74·6	40·5	51·8	12·9	67·4	75·7
Population on private works	668,785	1,336,091	190,876	537,124	764,664	400,072	406,448	466,861	4,770,921	180,347
Population per private work	3,980	4,930	6,000	13,080	6,435	4,080	4,564	4,280	5,180	6,679
P. C. of census city pop'n supplied by public works	87·5	85·2	72·6	22·1	83·6	58·1	62·4	16·5	77·5	....

works with few or none in use. The field for the further introduction of meters is therefore very great.

TABLE 15-S.

UNITED STATES AND CANADA WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	N'w'n.	S'w'n.	Pacific.	Total Far W'n.	Total Eastern.	Total U. S.	Total Canada.
Free	1	1	15	17	26	43	5
$5	....	....	2	2	9	11	....
10	....	....	2	2	16	18	....
15	....	....	....	....	29	29	....
20	....	....	4	4	22	26	1
25	....	1	6	6	24	30	....
30	1	2	2	5	33	38	1
35	1	1	....	2	26	28	1
40	3	2	4	9	44	53	2
45	1	2	1	5	27	32	1
50	13	12	4	29	60	89	7
55	3	....	....	3	8	11	....
60	9	8	1	18	24	42	....
65	2	4	1	7	....	7	....
70	4	4	....	8	....	8	1
75	12	4	....	16	24	40	....
80	5	4	11	20	....	20	....
85	3	6	1	10	....	10	....
90	....	3	....	3	4	7	....
95	....	....	....	....	....	....	....
100	18	15	3	36	5	41	1
120	....	....	1	1	....	1	....
125	....	1	....	1	....	1	....
150	....	1	....	1	....	1	....
160	1	....	....	1	....	1	....
Totals.	77	71	58	206	381	587	20
Average rate, including the w'ks reporting free rentals.	$70	$70	$40	$60	$35	$45	$35
Average rate, excluding the w'ks reporting free rentals.	70	75	50	65	40	50	50

The above includes all the works which report a hydrant rental separately Nearly all the private works receive an indirect rental of some stated sum including water supply of city buildings, etc. Some of the works have a sliding scale decreasing from the above rates for additional hydrants.

The hydrant rentals shown in Table 15, need no special comment, nor have we space for it, although this Table will have as great practical interest, perhaps, as any other. The variations in different groups, and in the same group, are great.

Table 16, showing pumping capacity, we must also leave to explain itself, calling especial attention to the note beneath it. It shows the enormous aggregate of 3,725,100,000 galls. daily pumping capacity, or about 34 times the present daily supply to New York City. The enormous volume of such a quantity of water will be better appreciated when we say that it is about one-fiftieth part of that falling over Niagara Falls; while the average height to which it is pumped is fully 120 ft., or more than three-fourths the height of the cataract. Only from one-half to two-thirds of this pumping capacity, however, is in daily use.

TABLE 16—S.

UNITED STATES AND CANADIAN WATER-WORKS.—PUMPING CAPACITY IN MILLIONS OF GALLONS PER DAY.

Makes of Pumps arranged alphabetically.	N. Eng.	Middle.	S. Atl.	So. C.	No. C.	N. W.	S. W.	Pacific.	Total U. S.	Canada.
Blake	21.4	26.1	4.2	34.2	51.5	30.5	25.9	3.0	196.8	5.5
Buffalo	......	5.5	......	......	......	10.6	5.5	......	21.6	......
Cameron	......	1.6	......	......	3.0	0.1	1.0	1.0	6.7	......
Corliss	20.0	22.0	......	......	......	......	......	......	42.0	......
Cornish	9.0	19.3	......	......	75.0	......	......	......	103.3	......
Davidson	12.5	28.7	......	5.0	3.5	......	......	......	49.7	......
Deane*	39.5	19.4	13.6	29.6	85.0	36.3	17.1	......	240.5	......
Dow	......	......	......	......	......	......	......	8.4	8.4	......
Gord. & Maxwell	......	8.5	5.1	7.5	62.3	20.1	5.8	......	109.3	2.0
Holly-Gaskill	17.5	156.9	21.0	60.0	276.8	78.6	60.1	12.8	683.7	4.0
Hooker	......	......	......	......	......	......	......	8.7	8.7	......
Knowles	19.5	32.1	8.9	9.1	62.4	36.2	16.0	5.3	189.5	3.7
Lang	6.5	8.2	......	......	......	......	......	......	14.7	......
Lowry	......	10.0	......	......	2.0	......	......	......	12.0	......
Smith & Vaile	......	......	4.0	......	18.1	7.6	13.2	......	42.9	......
Walker	......	......	......	......	31.6	......	2.0	......	33.6	4.9
Wetherill	......	12.0	......	......	......	......	......	......	12.0	......
Wood	9.5	6.0	5.0	......	......	......	......	......	20.5	......
Worthington	123.8	344.6	39.9	47.5	145.0	55.3	82.9	32.3	871.3	51.7
Wilson & Snyder	......	6.6	1.0	......	......	......	......	......	7.6	......
Misc. & Unrep'd†	62.9	273.7	37.3	33.2	351.1	133.5	136.8	21.8	1,050.3	72.9
Total	342.1	981.2	140.0	226.1	1,167.3	408.8	366.3	93.3	3,725.1	144.7

† The miscellaneous includes all pumps of unreported or unknown makes, all water-power pumps and all small or miscellaneous makes. It is estimated that the actual pumping capacity is at least 400 million gallons larger than shown above, many pumps having no capacity reported, and not a few pumps not being reported at all. The Worthington company have furnished the publishers a list showing 220 million gallons of daily pumping capacity in addition to the 871.3 capacity shown above, of which about half is included in our "Miscellaneous and unreported" total of 1,050.3 million gallons, and the remainder, or about 12 per cent., is not specifically included at all. It is probable that other makers could furnish a similar list, but as others have not done so, it was not deemed fair to correct the record of one maker only.

*These totals include about 20 million, more or less, of "Dean" pumps, an entirely different make. There was so much confusion in the spelling as to make it appear impracticable to separate the "Deane" and "Dean" pumps correctly in this issue; so both are given together.

TABLE 4—I-J.

CANADA MARITIME, INTERIOR AND WESTERN PROVINCES WATER-WORKS—SUMMARY BY PROVINCES OF THE MAIN STATISTICS GIVEN IN TABLE 3-C-D.

Province.	Pop'n on Water-Works 1880 census.	No. of Works	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue		Taps.	Hy-dr'ts	Me-ters.
New Brunswick	60,253	(1) 5	1,497,797	124,605	92.75	17,314	558	157
Nova Scotia	50,591	7	1,147,000	82,000	110	6,365	453	6
Prince Edw's Id.	11,485	1	165,000	5,000	15.25	195	88	......
Newfoundland	30,770	3	498,000	31,900	29	2,141	207	......
Totals, Maritime	153,099	(1) 16	3,307,797	243,505	247	26,015	1,3 6	163
Quebec	263,816	(2) 14	9,524,780	779,529	495.8	87,020	3,018	1,404
Ontario	312,128	35	7,731,232	843,535	583.35	57,374	4,706	481
Manitoba	8,000	1	250,000	40,000	20	600	150	......
British Columbia	......	2	500,000	48,500	25	1,938	134	29
Tot'ls, Int. & W'n	583,934	(2) 51	18,006,012	1,711,564	1,124	146,982	8,008	1,914
Total Canada	737,043	(3) 68	21,313,809	1,955,069	1,371	172,947	9,314	2,077

TABLE 5-I-J.

CANADA MARITIME, INTERIOR AND WESTERN PROVINCES WATER-WORKS.— SUMMARY BY DATES OF FIRST CONSTRUCTION OF THE MAIN STATISTICS OF ALL CANADIAN WATER-WORKS, AS USUALLY GIVEN IN TABLE 3.

CANADA MARITIME PROVINCES.

DATE.	Present pop'n of water-works.	No. of works.	Present Finances.		Miles of Mains.	Number of		
			Cost.	Revenue.		Taps.	Hy-dr'ts.	Me-ters.
1836-50	98,415	3	2,213,797	171,848	126.7	21,624	763	144
1851-60	....	....	....	....	....	....	......	......
1861-70	11,570	2	183,000	11,500	11.3	502	71	......
1871-80	8,544	2	140,000	11,400	15.	800	62	......
1881-85	18,506	5	453,000	22,857	49.75	2,079	226	19
1886-88	16,064	(1) 4	318,000	25.900	44.25	1,010	184	......
Total Maritime.	153,099	(1) 16	3,307,797	243,505	247.00	26,015	1,306	163

CANADA INTERIOR AND WESTERN PROVINCES.

DATE.	Present pop'n of water-works.	No. of works.	Cost.	Revenue.	Miles of Mains.	Taps.	Hy-dr'ts.	Me-ters.
1801-50	241,160	3	9,193,000	925,331	306.75	58,911	2,770	982
1851 60	101,442	3	3,280,000	263,581	115.8	16,415	855	......
1861 70	9,626	1	60,961	8,458	7.5	108	96	12
1871-80	126,719	(1) 16	2,982,939	297,565	482.7	63,476	2,871	91
1881-85	49,370	(1) 9	983,000	95,072	89	3,624	646	191
1886-88	48,006	17	1,132,112	71,957	90.4	1,790	682	6
Unknown.	7,621	3	375,000	49,600	32	2,608	88	29
Total Int. & Wn	583,934	(2) 52	18,006,012	1,711,564	1,124	146,932	8,008	1,914

GRAND TOTALS, CANADA MARITIME, AND INTERIOR AND WESTERN PROVINCES.

DATE.	Present pop'n of water-works.	No. of works.	Cost.	Revenue.	Miles of Mains.	Taps.	Hy-dr'ts.	Me-ters.
1801-50	329,575	6	11,406,797	1,097,179	433.45	80,535	3,533	1,126
1851-60	101,472	3	3,280,000	263,581	115.8	16,415	855	......
1861-70	21.196	3	243,961	19,958	18.8	610	167	12
1871-80	135,263	(1) 18	3,122,939	308,965	497.7	64,276	2,933	694
1881-85	67,876	(1) 14	1,436,000	117,929	138.75	5,703	872	210
1886-88	6 ,070	(1) 21	1,450 112	97,857	134.65	2,800	866	6
Unknown.	7,621	3	375,000	49,600	32	2,608	88	29
Grand T'tls.	737,013	(3) 68	21,313,809	1,955,069	1,371	172,947	9,314	2,077

NOTICE.

Water-Works Officials

will greatly oblige us by mailing to us their latest **Annual Reports** and **Schedules of Water Rates,** and by giving notice of any errors or omissions they may find in the description of their works.

Hydraulic Engineers and Contractors

will likewise favor us by noting errors or omissions, and by informing us of new water-works with which they are connected, or of which they have knowledge.

ENGINEERING NEWS

MANUAL OF

AMERICAN WATER-WORKS.

1888.

GROUP I.--New England States.--Water-Works Completed, in Process of Construction or Projected, in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

MAINE.

Water-Works Completed and in Process of Construction.

AUBURN, *Androscoggin Co.* (Pop., 9,600; est., 10,000.) On west bank of Androscoggin river, on land rising 55 ft. between river and range of hills half a mile distant. Settled in 1786, incorp. a city in '69.

History.—Works built in '69 by Auburn Aqueduct Co. Des. Engr., J. Herbert Shedd, Providence, R. I. Const. Engr. and Supt., F. M. Jordan, Auburn, Me.

Water Supply.—From Lake Auburn by gravity, with pumping for fire protection. Lake is 118 ft. above, and three miles north of city. Area, 5 sq. m., beyond which it has a limited drainage basin. Lake has nearly level, sandy bottom, with general depth of 30 to 35 ft., and several deep holes, one being 300 ft. in diam. and 119 ft. deep.

Conduit.—A 12-in. c. i. pipe for ¾ mile, thence 10 ins. to city.

Pumping Machinery.—One upright, one horizontal boiler. Two Worthington compound pumps, combined dy. cap., 600,000 galls.

Tank.—Made by Cunningham Iron Works, Boston. Plate-iron, 60 ft. in diam., 18 ft. high, on Goff's hill 4,000 ft. from river and 230 ft. above city. Water lifted 173 ft. and taken from conduit, 63 ft. below level of pond, at point where size of pipe is diminished.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, 12. *Hydrants*, Whittier Machine Co., Chapman Valve Co., 60.

Consumption, 600,000 galls. *Pressure*: ordinary, 52 lbs. Fire, 200 lbs.

Financial.—Cost of works, $250,000, all paid up stock. Ann. op. exp., $4,000. Ann. rev.: consumers, $17,000; city, $25,000. Hydrant rental, terms of franchise give exemption from taxation.

Management.—Prest. and Supt., F. M. Jordan.

AUGUSTA, *Kennebec Co.* (Pop., 8,665; est., 11.000.) On Kennebec river at head of tidal navigation, on ground rising from river to a considerable elevation. A dam in river furnishes valuable water power.

History.—Built by a company in '73, extended by Augusta Water Co., '85—'7. Des. Engr., J. Herbert Shedd, Providence, R. I. Const. Engr., E.B. Cummings.

Water-Supply.—Originally, by gravity from impounding reservoir on small stream; new works, pumping from Kennebec river to reservoir.

Reservoirs.—Old, impounding, 3,000,000 galls. New earth reservoir 329 ft. above Kennebec River; cap., 10,000,000 galls.

Pumping Machinery.—Made by R. D. Wood & Co., Philadelphia, Pa.; dy. cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 22 miles. *Services*, originally galv. and w. i. *Taps*, number withheld. *Meters*, none. *Hydrants*, Chapman, 90.

Consumption, 400,000 galls. *Pressure*: Ordinary, 120 lbs. Fire, 130 lbs.

Financial.—Capital stock, $22,000. Bonds, $100,000. Int. 5%. Ann. rev.: city, $2,700. Hydrant rental, $30. Other financial data withheld.

Management.—Prest., Geo. P. Westcott, Portland; Treas., J. H. Manly; Supt., W. H. Williams.

BANGOR, *Penobscot Co.* (Pop., 16,857; est., 19,000.) On west bank of Penobscot river, at its junction with the Kenduskeag, about 55 miles from ocean. Above city both rivers are broken by falls, affording good water-power. Incorp. a town in 1791, city in '34.

History.—Built in '75-'6 by city, when population was 12,000. Const. Engr., F. H. Eaton, long time Engr. of the works. Contrs., Holly Manufacturing Co., Lockport, N. Y.

Water Supply.—Penobscot river, direct pumping, there being an impounding dam and a filter gallery. The river has a drainage basin of 7,200 sq. m. mostly covered by forest.

Dam.—At Treat's Falls, where there are rapids falling 22 ins. Tide has mean rise and fall of 12 ft. River bottom is of slate ledge, irregular, with trench at angle of 45 degrees with flow of stream. Dam has overflow of 900 ft., and its crest is 8 ft. above mean high tide. Has granite abutments 10½ ft. higher than crest of dam, and wing walls. Dam is of crib-work, filled with stone, lower part being built up with timber to a level at top of irregularities in river bottom. Crib bolted with ⅞-in. iron bolts and solidly backed with stone, then covered with 6-in. hemlock plank. Toe of dam filled and covered to depth of from 8 to 10 ft. with gravel and stone. Cost of dam, $150,000.

Filter Galleries.—Water is conducted from the dam by means of a flume to a filter, first passing through a revolving screen of copper wire netting. The filter has two chambers, each 12½ ft. wide by 150 ft. long with filter beds of brick, gravel and sand. From the filter the water passes to the suction pipes leading to the pumps.

Pumping Machinery.—Four Holly piston pumps and rotary pump driven by water power, also Gaskill steam pump. The four piston pumps have 12-in. cylinders and 27-in. stroke, are mounted at the four corners of the base of a heavy cast-iron frame and connected to crank-shaft above. Shaft carried in boxes on upper parts of frame, with two pumps on each side of shaft connected to crank-pin; piston-rods at angle of 45 degrees with vertical; the two crank-pins at opposite ends of the shaft are so disposed that the pumps take suction and discharge at 8 equidistant points for each revolution, securing uniform flow into main. Any pump can be disconnected, so that one or more can be run at one time. These pumps are supplemented by an elliptical rotary pump, cap., 16 galls. per revolution. This set of pumps now has dy. cap. of 3,000,000 galls. and is driven by three American turbine wheels made by Stout, Mills & Temple, Dayton, O. The wheels are 84 ins. in diameter, and are run with a head varying with the tide from 5 to 14 ft. The Gaskill compound pumping engine has a high pressure cylinder 14 in. in diameter with 24-in. stroke, and a low pressure cylinder 21 in. in diameter with 30-in. stroke. Both can be worked at high pressure. Dy. cap., 5,000,000 galls. There are two horizontal tubular boilers having a smoke-stack 70 ft. high.

Buildings.—Boiler-rooms, 36 by 40 ft.; pump and engine-room, 50 ft. sq.; whee house 39 by 44 ft., with tenement for engineer above.

Distribution.—*Mains*, c. i., 26 miles. *Services*, galv. i. *Taps*, 2,452. *Meters* none. *Hydrants*, Holly, 167. *Valves*, Eddy.

Consumption, 1,874,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—(For '86.) Cost of works, $500,000. Debt, $500,000. Int., 6%. Ann, op. exp., $5,000. Ann. rev.: consumers, 35,000; city, $6,680. Hydrant rental, $40.

Management.—Water Board. Supt., F. E. Sparks. Pump'g Eng'r, W. W. Fellows. Clerk, G. W. Snow.

NOTE.—For a more detailed description see *Eng. News*, Vol. IV., pp. 59 60.

BAR HARBOR, *Hancock Co.* (Pop., 624; est., winter, 1,800, summer, 4,000. A summer resort on Frenchman's Bay.

History.—Built in '74 by Bar Harbor Water Co.

Water Supply.—Eagle lake, by gravity. Lake 2 miles long by ¼ mile wide.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Matthew, 20. *Valves*, Eddy, Chapman.

Consumption, not known. *Pressure*: Ordinary, low levels, 90 lbs. Fire, do., 90. To be raised summer of '88 to120 lbs. by introduction of main connecting directly with lake.

Financial.—Stock, $50,000. Cost, $150,000. No debt. Hydrant rental, free. No other financial data given.

Management.—F. Rodick, Agt. and Mgr.; Supts., S. L. Kingsley, A. H. Grindle.

BATH, *Sagadahoc Co.* (Pop., 7,884; est., 8,000.) On Kennebec river, 12 miles from its mouth. Has superior advantages for navigation.

History.—Built in '86-7 by National Water Works Syndicate, Boston. Sold in July, '88, to H. M. Payson & Co., Bankers, Portland.

Water-Supply.—Thompson's brook, pumping to tank.

Distribution.—*Mains*, c. i., 17 miles. *Services*, galv. i. *Taps*, 600. *Meters*, 8. *Hydrants*, kind not given, 114.

Financial.—Stock, $500,000. Bonded debt, $200,000. Int., 5%. Ann. rev.: city, $4,420.

Management.—Owned and controlled by H. M. Payson & Co., Portland. No other information has been given.

BELFAST, *Waldo Co.* (Pop., 5,308; est., 5,800). At head of Penobscot Bay; has fine harbor. Engaged in shipbuilding, manufacturing, and domestic commerce.

History.—Built in '87 by Belfast Water Co., under a 20 years' franchise. Des. and Const. Engrs. and Contrs., Wheeler & Parks, Boston, Mass. Sub.-Contrs. for, trenching and pipe laying, Ferris & Halladay, Jersey City, N. J.

Water Supply.—Little river, by pumping to tank.

Pumping Machinery.—Two Deane pumps, one compound, 700,000 galls. dy. cap.; one, 1,000,000 galls. dy. cap.

Tank.—Furnished by E. Hodge & Co., E. Boston, Mass., 30 ft. diam., 45 ft. high.

Distribution.—*Mains*, c. i., furnished by Builders' Iron Foundry, Providence, R. I., 8½ miles. *Services*, enam. w. i. *Taps*, 125. *Meters*, 4. *Hydrants*, Coffin, 45, *Valves*, Coffin.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, not given.

Financial.—Stock, $100,000. Bonds, $65,000. Hydrant rental, $45. No other data given.

Management.—Prest., Chas. J. Gilman. Supt., Chas. Baker.

BIDDEFORD & SACO, *York Co.* (Pop., Biddeford, 12,651; est., 12,651. Saco, 6,389; est., 6,396.) On opposite sides of Saco river, 6 miles from its mouth. Both villages engaged in manufacturing.

History.—Built in '84-'5 by the Biddeford & Saco Water Co. Engr., E. B Cummings, Portland, Me.

Water Supply.—From Saco river by pumping to reservoir.

Reservoir.—Stone, 10,000,000 galls. cap.; 200 ft. above Saco river at tide level.

Pumping Machinery.—Deane, 3,000,000 galls. dy. cap.

Distribution.—*Mains*, c. i. 23 miles. *Services*, galv. i. *Taps*, 13,000. *Meters*, 6. *Hydrants*, R. D. Wood & Co., 109.

Consumption, 776,071 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Stock and bonds, $60,000. Int., 5%. Hydrant rental, $50 each for 10 years, afterwards free. Ann. rev.: $5,450. Other financial data withheld.

Management.—Prest., D. W. Clark. Treas., Geo. P. Westcott, Portland. Supt not given.

BOOTH BAY, *Lincoln Co.* (Pop. 1,000; est., 3,000.) On Atlantic coast. Engaged in fishing and ice trade.

History.—To be built by Booth Bay Water Co., under a franchise of 25 years. Des. and Const. Engr., H. A. Hancox, Hudson, Mass. Work was begun about June 1 and will be completed in Oct., '88.

Water Supply.—Lowes' Pond and springs, by pumping to stand-pipe.

Pumping Machinery.—Volker & Felthousen, duplex, compound condensing; dy. cap., 1,000,000 galls.

Stand-Pipe.—To be built by E. Hodge & Co. Size, 30 by 48 ft.; cap., 250,000 galls.

Distribution.—*Mains*, i., 46 miles. *Services*, i. Pipes and specials made by R. D. Wood & Co. *Hydrants*, R. D. Wood & Co., 22.

Financial.—Cost, $69,000. Stock, $50,000. Debt and Int., not given. Hydrant rental, $62.91 for 22; $50 for additional.

Management.—Prest., H. A. Hancox, Hudson, Mass. Sec. and Treas., Chas. H. Fisher. Supt., not appointed.

BREWER, *Penobscot Co.* (Pop., 3,170; est., 3,207.) On Penobscot river, opposite Portland.

History.—Built in '83 by Brewer Water Co.

Water Supply.—Bangor Water-Works, direct pumping through main on bridge over Penobscot river.

Distribution.—*Mains*, c. i., 2 miles, 3 miles to be laid summer of '88. *Taps and Meters*, number not given. *Hydrants*, Holly, 4, and 16 to be set summer of '88.

Consumption, not given. *Pressure*: Ordinary, 100 lbs.; Fire, 130 lbs.

Financial.—Stock, $50,000. Bonds, authorized, $75,000. Cost, $12,000. Debt, $3,000. Ann. op. exp., $800. Ann. rev.: consumers, $1,500; city, to be $800. Hydrant rental, $40.

Management.—Prest., F. M. Laughton. Treas., F. H. Clergue. Clerk, F. A. Floyd.

NOTE:—These works are to be extended.

BRUNSWICK, *Cumberland Co.* (Pop., 5,384; est., 6,000.) On Androscoggin river. Engaged in lumber trade and manufacturing.

History.—Built in '86-'7, by Pejepscot Water Co. Engr., E. B. Cummings. Contr., Eph. Dyer, Portland.

Water Supply.—Androscoggin river, pumping to stand-pipe. Also springs collected in reservoir.

Pumping Machinery.—Two 50 H. P. steel tubular boilers. Two Deane compound, duplex pumps, 1,000,000 and 500,000 galls. dy. cap., each.

Stand-pipe.—40 ft. diam., 70 ft. high. Dy. cap., 625,000 galls.

Reservoir.—Impounding, cap., 7,000,000 galls.

Buildings.—Brick, with foundations, and all other masonry for works, of stone.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 210. *Meters*, 210. *Hydrants*, R. D. Wood, 60.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, not given.

Financial.—Debt, in '86, $100,000. Int., 5%. Ann. rev.: city, $2,000. Hydrant rental, $33.33 each.

Management.—Prest., Stephen J. Young. Treas., Geo. P. Westcott, Portland, Me. Supt., I. H. Simpson.

CALAIS, *Washington Co.* (Pop., 6,173; est., 6,000.) At head of navigation on St. Croix river. Engaged in ship-building and lumber trade.

History.—Built in '86, by Calais Water Co. An extension of the system supplies St. Stephen and Milltown, N. B. Des. Engr., M. M. Tidd, Boston, Mass. Const. Engr., H. G. Dennis, New Bedford, Mass. Contr., Jas. J. Newman, Providence, R. I.

Water Supply.—St. Croix river, by gravity from filter crib in river to suction well, thence by pumping to reservoir.

Pumping Machinery.—Blake pumps, one duplex, compound, condensing, 2,000,000 galls. dy. cap. One high pressure, 1,000,000 dy. cap.

Reservoir.—On Todd's mountain, Milltown, N. B., 125 miles from pump-house, and 222.5 ft. above high water in St. Croix river at Calais. Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 15 miles. *Services*, tarred iron. *Taps*, 300. *Meters*, none. *Hydrants*, Chapman, 60. *Gates*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire 80 lbs.

Financial.—Capital stock. $200,000. Bonds, $120,000. Int., 5%. Hydrant rental, $50 each, $3,000. No other financial data given.

Management.—Prest., Weston Lewis. Treas., Josiah S. Maxey, Gardiner. Supt., H. W. Rogers.

CAMDEN, *Knox Co.* (Pop., 4,386; est., 4,500.) On Penobscot Bay, 8 miles north of Rockland. Engaged in ship-building, ice-cutting and lime-burning.

History.—Supplied by Camden & Rockland Water Co. in '87. All other data included under Rockland.

CUMBERLAND MILLS, *Cumberland Co.* (Pop., est., 2,225.)

History.—Supplied with water in '70, by Portland Water Co.

Water Supply.—This and all other data included in account of Portland.

DEERING, *Cumberland Co.*—(Pop. of town, 4,324; est., 6,000.)

History.—Supplied with water in '79 by Portland Water Co's Works.

Water Supply.—This and all other data included in account of Portland.

DIAMOND ISLAND, *Cumberland Co.* (Pop., est., 400.) Small island in Portland harbor upon which are a few summer cottages.

History.—Built in '87 by Diamond Island Water Co.

Water Supply.—Springs, pumped to reservoir at a height of 70 ft. Water used both for fire protection and domestic purposes.

Financial.—Cost, $5,000; stock subscriptions. Dividend of 7 per cent. declared at close of last season.

Management.—Board of Directors. Prest., Franklin M. Lawrence. Sec. and Treas., Seth. L. Larrabee.

No further official data given, but it is reported that the works will be enlarged in '88 by adding a new wind engine and reservoir and extending the mains.

DOVER AND FOXCROFT, *Piscataquis Co.* (Pop., Dover, 1,647; est., 4,000.) On Piscataquis river. Engaged in manufacturing.

History.—Built in '87 by Dover and Foxcroft Water Co. under a 40 years' charter. Const. Eng., F. Danforth, Gardiner. Contr., J. J. Newman, Providence, R. I.

Water Supply.—Piscataquis river, by pumping to reservoir.

Pumping Machinery.—Deane pump, cap., 750,000 galls.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, tarred iron. Pipes and specials made by Warren Foundry and Machine Co. *Taps*, not given. *Meters*, none. *Hydrants*, Chapman, 30.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire 70 lbs.

Financial.—Stock and bonds, $160,000. Debt, $60 000. Int., 5 %. Ann. rev.: city, $1,500. Hydrant rental, $50. Other financial data withheld.

Management.—Prest., Weston Lewis. Treas., Josiah D. Maxey, Gardiner. Supt., J. A. Goodwin.

FAIRFIELD, *Somerset Co.* (Pop., 3,044; est., 5,000). On Kennebec river, near Fairfield. Engaged in lumbering and manufacturing.

History.—Supplied in '87 by Waterville Water Co. All data included under Waterville.

CRAFT, *Piscataquis Co.* (Pop., whole town, 1263). On Piscataquis river, opposite Dover.

History.—Supplied in '87 by Dover & Foxcraft Water Co. All data included under Dover.

FRYEBURG, (Pop., est., 700). On a level sandy plain with out-lying granite hills 100 to 1,000 ft. high. Settled in 1763, never incorp.

History.—Built in '82 by Fryeburg Water Co. Des. Engr., D. L. Lamson, Const. Engr., A. R. Jenness.

Water Supply.—Mountain stream with drainage area of 800 acres, by gravity from reservoir.

Reservoir.—Formed by building cement laid, granite masonry dam across stream three miles from, and 155 ft. above, village, making reservoir 60 by 100 ft., and usually fed with 2,000,000 galls. daily.

Conduit.—Cast-iron pipes 10 and 6 ins. in diam.

Distribution.—*Mains*, c. i., 6.5 miles. *Services*, tarred c. i. *Taps*, 135. *Meters*, none. *Hydrants*, Matthews, 23.

Consumption, 20,000 galls. *Pressure*: Ordinary, 55 to 60 lbs. Fire, 55 to 60 lbs.

Financial.—Cost, $20,000. Paid up stock, $17,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, 1,700; city, $115. Hydrant rental, $5.

Management.—Prest., Thomas C. Shirley. Sec'y, D. L. Lamson. Supt., A. R. Jenness.

GARDINER, *Kennebec Co.* (Pop., 4,439; est., 6,000). At head of steamboat navigation on Kennebec river. Engaged in manufacturing and commerce, especially lumber trade.

History.—Built in '85 by Gardiner Water Co., under 20 year's franchise. Engr., M. M. Tidd, Boston, Mass., Contr., J. J. Newman, Providence, R. I.

Water Supply.—Cobbossee Contee river. A dam being thrown across the river 124 ft. above tide forms a pond from which water is pumped to reservoir.

Pumping Machinery.—Blake pump, duplex, 12-in. cylinder, 18-in. stroke; 1,200,000 galls. dy. cap.

Reservoir.—112 ft. above dam and about 12 ft. above lower streets in Gardiner. Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, tarred w. i. *Taps*, 580, *Meters*, 4. *Hydrants*, Chapman, 65.

Consumption, 200,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Capital stock, $250,000. Bonds, $150,000. Int., 5 %. Ann. rev.: $3,300. Hydrant rental, $50. No other financial data given.

Management.—Prest., Weston Lewis. Treas., Josiah S. Maxey. Supt., J. F. Nash.

HALLOWELL, *Kennebec Co.* (Pop., 3,151; est., 3,500). On Kennebec river. Exports granite and ice, and has some manufactories.

History.—Built in '76 by Hallowell Water Co.

Water Supply.—Springs collected in reservoirs, thence by gravity to village.

Reservoirs.—Three. One 80 ft. sq. and 9 ft. deep, 100 ft. above city. Others 65 ft. above city: one 20 ft. sq. and 9 ft. deep and one 80 by 90 ft.

Distribution.—*Mains*, c. i., w. i., 5 miles. *Services*, galv. i. Were originally rubber coated iron which stood well in some places and corroded badly in others. *Taps*, about 175. *Meters*, none. *Hydrants*, Whittier, 1.

Consumption, unknown. *Pressure*, 100 lbs. down.

Financial.—Cost of works, $20,000. No bonds. Debt, $4,000. Int., 6 %. No further data given.

Management.—Prest., no election since death of J. R. Bodwell. Secy., Treas. and Supt., Orlando Currier.

HOULTON, *Aroostook Co.* (Pop., 3,228; est., 4,000.) Engaged in farming and manufacturing.

History.—Built in '85 by Houlton Water Co. under a perpetual charter. Engr., Arthur W. Forbes, Boston, Mass. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Surface water from stream fed by springs; pumping to standpipe.

Pumping Machinery.—Boilers made by Whittier Machine Co. Two Worthington Pumps, each 500,000 galls. dy. cap.

Stand-pipe.—Iron, 20 ft. diam., 50 ft. high, on 10 ft. of masonry. Made by Kendall and Roberts.

Distribution.—*Mains*, c. i., 5 miles. *Services*, enam. i. Pipes and specials made by Warren Foundry & Machine Co. *Taps*, 136. *Meters*, 2. *Hydrants*, Mathew, 32. *Gates*, Coffin.

Consumption, 30,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Stock, $50,000. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,600; city, $1,650. Hydrant rental $75 each for 22 only.

Management.—Prest., Walter Mansur. V. Prest., Black Hawk Putnam. Secy., Treas. and Supt., James Frank Holland.

KENNEBUNK, *York Co.* (Pop., 2,852; est., 3 000.) Engaged in manufacturing shoes and leather goods.

History.—Works built by town for fire protection only. Date not given.

Water Supply.—By pumping.

Pumping Machinery. —One Deane pumping engine and two water-power force pumps.

Distribution.—*Mains*, c. i., 1,900 ft. *Hydrants*, 4. No further data given.

LEWISTON, *Androscoggin Co.* (Pop., 19,083; est., 23,500.) On Androscoggin river, on undulating ground rising from the river to hills 350 ft. high. Opposite the city the river falls 70 ft., affording good water-power, which is used for manufacturing cotton and woolen goods, boots and shoes, lumber and machinery. Incorp. a town in 1795, chartered as city in '63.

History.—Built by city in '78-9. Engr., M. M. Tidd, Boston, Mass.

Water Supply.—Androscoggin river, pumping to reservoir. Source of river is a chain of mountain lakes 100 miles above Lewiston and having drainage basin of 80 sq. m.

Brick Conduit.—Takes water from the pond above the falls to the pump-well through a sand and sea-gravel filter of 400 sq. ft. area. Filter built in '80. Water passes through gravel and falls over a weir into pump-well.

Pumping Machinery.—Two Worthington duplex pumps, 3,000,000 galls. combined dy. cap.; driven by two Risden turbines. Water is lifted 250 ft. to reservoir through 10,450 ft. of 24-in. c. i. pipe.

Reservoir.—Excavation and embankment on hillside, one side level with natural earth, other consists of earth embankment; 15 ft. wide on top, inner slopes lined with cobble-stones. The outer slope is 1 to 2. The embankment has in its center a 16-in. brick piling wall. The reservoir is 220 ft. above general level of city.

Distribution.—*Mains*, c. i., 24.9 miles. *Services*, w. i. Pipes and specials made by McNeal Pipe and Foundry Co., Burlington, N. J. *Taps*, 1,946. *Meters*, 7; *Hydrants*, Chapman, 149. *Valves*, Chapman.

Consumption, 1,600,000 galls. *Pressure*: Ordinary, 65 to 90 lbs. Fire, 65 to 90 lbs.

Financial.—Cost. $519,940. ($200,000 for water-power and privileges.) Bonded debt, $500,000. Int., 4%. Ann. op. exp. $4,795. Ann. rev.: consumers, $30,615; city, $35,189. Hydrant rental, $40 each.

Management.—Seven commissioners, one elected by City Council each year. Officers of board are: Prest., Clerk, Registrar, and Supt. Names of each not given, except Supt., L. C. Peck.

LITTLE FALLS, *Cumberland Co.* (Pop., est., 1,500.)

History.—Supplied by Portland Water Co. in '79. Further data included in account of their works.

NORWAY and SOUTH PARIS, *Oxford Co.* (Pop., Norway, 1,467; est., 3,400. Combined, est., 6,000.) Norway largely engaged in manufacturing.

History.—Built in '86 by National Water-Works Syndicate, Boston, Mass., being one of the first systems constructed by this company.

Water Supply.—Surface water, pumping to reservoir.

Financial.—Bonded debt, $50,000. Int., 5%. Revenue from hydrant rental pays interest on bonds. Stock in May said to be worth 115.

Management.—Genl. Mgr., B. C. Mudge. Chf. Engr., Geo. Alexander. Offices, 70 Kilby St., Boston, Mass. No further information given.

OLD ORCHARD, *York Co.* (Pop. est., winter, 1,000; summer, 5,000.) On Saco Bay, a summer watering place.

History.—Built in '87 by Old Orchard Water Co. under a 20 years' franchise. Des. Engr., B. R. Clarke; Const. Engr., M. M. Tidd; Contrs., Turner, Clarke & Rawson. All of Boston, Mass.

Water Supply.—Spring flowing into reservoir three miles from town; gravity, with direct pumping for fire protection.

Pumping Machinery.—Herreshoff boiler. Blake pump, single duplex, dy. cap., 1,000,000 galls.

Reservoir.—At Spring, roofed. Cap., 390,000 galls.

Distribution.—*Mains*, c. i., 6¾ miles. *Services*, galv. i. *Taps and meters*, laying services at time of report. *Hydrants*, Chapman, 25. *Valves*, Chapman.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Stock, $75,000. Bonds, none. Hydrant rental, $40. Further financial data not determined.

Management.—Prest., A. B. Turner. Treas., J. Wentworth Brown. Supt., J. W. Duff.

PORTLAND. *Cumberland Co.* (Pop., 33,890; est., not given. Combined pop. of Portland, Deering and Westbrook, est., 52,000) On peninsula in Casco bay, ¾ mile wide by 3 miles long. Land rises each way from center of city to elevations of 161 and 175 ft., respectively. Settled in 1632; incorp. a town, 1786; a city in '32. Engaged in commerce and shipping interests, and manufacturing.

History.—Built in '67-'9 by Portland Water Co., which has since supplied villages along pipe line from Lake Sebago through townships of Deering and Westbrook. The villages and years first supplied are: Cumberland Mills, '70; Deering, '79; Little Falls, '70; Saccarappa, '70, and Westbrook, '70. The distributing systems for these villages were put in and are now operated by the Portland Water Co. Previous to '69 water had been taken wholly from wells and cisterns.

Water Supply.—Lake Sebago, by gravity through 16 miles of pipe to the city. The Presumscot river is the only outlet of the lake, and the supply is controlled by a dam at its source. A reservoir is used for a reserve supply. Lake Sebago is 14 miles long, 6 wide, and has a drainage basin of 500 sq. m. At high water the lake is 267 ft. above the city.

Dam.—Masonry, built in '79 at cost of $50,000.

Conduit.—Water from the lake is first received into a box conduit 4 ft. sq. fitted with screens, then passes into an oval brick conduit 5,440 ft. long, said to have cost $120,000, to a second gate-house, from which it enters a 20-in. cement pipe conveying the water directly to the city. In '76, another line of pipe was laid, consisting of 29 in. w. i. and cement pipe, from the lake to Ward's Hill, 4 miles, and 24 in. pipe thence to the city. The dy. cap. of the two mains is estimated at 7,500,000 galls.

Reservoirs.—Two, one of 20,000,000 and one 10,000,000 galls. cap. The latter is on Branchall's hill, and is for a reserve supply in case of accident to the conduits, the surplus water from these being discharged into the reservoir nightly. June 9, 1882, one of the reservoirs burst and in 30 minutes discharged 6,000,000 galls. of water into the streets of the city, causing some damage but injuring no one. The first leak was between the blue clay and parapet of the reservoir embankment. Cost of repairs $5,000. A new reservoir is being built in 1888, on Munjoy Hill.

Distribution.—*Mains*, the first laid were of w. i. and cement, all others c. i.; 96 miles. In 1882 much trouble was caused by the blowing out of lead joints in the submerged main under Little river. As soon as one joint was repaired another one would blow out. An air-valve near the bend where the pipe dips in the river did no good, the difficulty not being overcome until a pile and timber foundation was placed under 50 ft. of the main. The supply in the reserve reservoir furnished the city with water meanwhile. *Services*, galv. i., it being said that the purity of the water oxidizes ordinary iron pipes, reducing the supply and even cutting it off. *Taps*, 6,425. *Meters*, 152. *Hydrants*, Eddy, and Whittier Machine Co., 276.

Consumption, 5,000,000 galls. *Pressure:* Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Debt, $1,500,000. Int., 4, 5 and 6 %. Ann. op. exp., $15,000. Hydrant rental, free in Portland. No further information given.

Management.—Five directors. Prest., D. W. Clark. Secy., E. R. Payson. Treas. and Supt., Geo. P. Westcott.

PRESQUE ISLE, *Aroostook Co.* (Pop., 1,305; est., 2,500.) On Presque river. Town engaged in agriculture, lumbering and manufacturing.

History.—Built in '87 by National Water Works Syndicate, Boston, Mass. Chf. Eng., Geo. Alexander. Offices, 70 Kilby St., Boston, Mass.

Water Supply.—Gravity system, with 5 miles of mains.

Financial.—Stock, $3,000. Bonds, $30,000. Int., 5 %.

Management.—Genl. Mgr., Alex. B. Mudge. Chf. Engr., Geo. Alexander. Supt., Geo. H. Freeman.

No other data given.

RANDOLPH, *Kennebec Co.* (Pop., not given.) Supplied in '88 from Gardiner Water-Works; 1000 ft. of pipe having been laid across Kennebec river to connect the two systems. H. G. Dennis, New Bedford, Mass., did the work. 10 hydrants at $150 each. No other data given.

ROCKLAND, CAMDEN AND THOMASTON, *Knox Co.* (Pop.: Rockland, 7,599; est., 7,700. Camden, 4,386; est., 4,500. Thomaston, 3,017; est., 3,017.) Rockland, on Penobscot bay, engaged in ship-building and commerce. Incorp. a city in '54. Camden, on Penobscot bay, 8 miles north of Rockland, engaged in ship-building, ice-cutting and manufacture of lime. Thomaston, on Georges river, 4 miles west of Rockland, engaged in ship-building and manufacture of lime.

History.—First supplied in '51 by Rockland Water Co., which had a monopoly until '85, when the Camden and Rockland Water Co. began to operate a competing system. In '87, the latter system was extended to supply Camden and Thomaston. Engr., Percy M. Blake, Hyde Park, Mass.

Water Supply.—Lake, 7 miles distant, fed by mountain springs, by gravity to reservoir.

Reservoir.—On Juniper hill, reported as having clay walls; gravelled, sides and bottom lined with granite blocks. Cap., 2,500,000.

Distribution.—*Mains*, furnished by R. D. Wood & Co., and Warren Foundry Co., 80 miles. *Services, Taps, and Meters*, not given. *Hydrants*, 112, these, and *Valves*, furnished by R. D. Wood & Co., and Ludlow Valve Co.

Consumption, not given. *Pressure*: Ordinary, Rockland, 95 lbs., Camden, 130 lbs., Thomaston, 95 lbs.. Fire, do. for each place.

Financial.—Hydrant rental, $50. Other data withheld.

Management.—Prest., A. G. Crockett. Treas., W. S. White. Clerk J. W. Crocker.

SACCARAPPA, *Cumberland Co.* (Pop., not given; est., 3,251.) In town of Westbrook. Engaged in manufacturing.

History.—Supplied by Portland Water Co. in '70. Pays $2,000 a year for water for all purposes. Further data included in account of this company's work.

SACO, *York Co.* (Pop., 6,389; est., 6,396.) On Saco river, 6 miles from its mouth. Engaged in manufacturing.

History.—Built in '84-'5 by Biddeford & Saco Water Co. Further data included in account of their works.

SANFORD, *York Co.* (Pop., est., 1,457.)

History.—Built in '87 by Sanford Light & Water Co. under direction of E. M Goodall. Are making extensions.

Water Supply.—Springs, by direct pumping for fire purposes and pumping to tank. Pipe being laid for gravity supply.

Pumping Machinery.—Eclipse windmill, 20 ft.; dy. cap., 25,000 galls. In case of fire connection is made with pumps in mill.

Tank.—Furnished by L. H. Wheeler, Boston, Mass.; 24 ft. in diam., by 16 ft. deep; cap., 51 800 galls.

Distribution.—*Mains*, c. i., 7,695 ft.; extending. *Services*, not given. *Taps*, 105, expect to add 75 in '88. *Meters*, none. *Hydrants*, Chapman, 12. *Valves*, Chapman. Pipes and specials furnished by R. D. Wood & Co., Philadelphia.

Consumption, 6,000 galls. *Pressure*: Ordinary, 15 lbs. Fire, 65 lbs.

Financial.—Cost, $10,000, stock. To give note for $5,000 at 6% to raise money for extensions. Ann. op. exp., $50. Ann. rev.: Consumers, $832. Hydrants were put in by subscription, and rental is free.

Management.—Prest., E. M. Goodall. Secy., E. E. Hussey.

SKOWHEGAN, *Somerset Co.* (Pop., 3,860; est., 5,000.) On Kennebec river. Engaged in lumbering, manufacturing and farming.

History.—Begun in '87 by Skowhegan Water Co. To be finished in '88. Under control of National Water Works Syndicate, Boston, Mass. Des. Engr., Geo. Alexander, Boston, Mass. Const. Engr., E. H. Gowing, Skowhegan. Work done by company.

Water Supply.—Springs, by pumping to stand pipe.

Pumping Machinery.—Horizontal, tubular boiler. Two Worthington compound, condensing, duplex pumps; dy. cap., 1,000,000 gal's. each.

Stand Pipe.—Made by E. Hodge & Co., East Boston, Mass.; 25 ft. diam., by 75 ft. high.

Distribution.—*Mains*, c. i., furnished by M. J. Drummond, New York, 12 miles. *Services*, Rustless w. i. *Taps and meters*, not given. *Hydrants*, R. D. Wood & Co., 75. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 70 to 90 lbs. Fire, 70 to 90 lbs.

Financial.—Stock, $250,000. Bonds, $125,000. Int., 5%. No other financial data given.

Management.—Genl. Mgr., B. C. Mudge. Chf. Engr., Geo. Alexander. Supt. not appointed. Offices, 70 Kilby St., Boston, Mass.

SO. PARIS, *Oxford Co.* (Pop., est., 2,000.) Engaged in commerce and manufacturing.

History.—Built in '86 in connection with system at Norway, by National Water Works Syndicate, Boston, Mass. All data included under Norway.

SORRENTO, *Hancock Co.* (Pop., not given.)

History.—Built in '87 by the Frenchman's Bay and Mt. Desert Land and Water Co., 17 Milk St., Boston, Mass., under charter granted to Long Pond Co., of Sullivan, Me., of which Chas. P. Simpson is Clerk.

Water Supply.—Long Pond, three or four miles from village. No other data given.

SPRINGVALE, *York Co.* (Pop., 1,118; est., 1,300.) On Mousam river, 12 miles from Rochester, N. H. Engaged in lumber and general trade, and has cotton and shoe factories.

History.—Built in '76 by Springvale Aqueduct Co., the works being designed by one of the owners, M. Dennett, and constructed by the company.

Water Supply.—Pond, by gravity. Pond covers 40 acres, is 1¼ miles from, and 167 ft. above the village.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 150 in '84. *Meters*, none. *Hydrants*, plain 2-in., 4.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, not given.

Financial.—Cost, $10,000. No other data given.

Management.—Prest., Saml. D. Tibbett. Treas., Clerk and Supt., Jno. A. Bennett.

THOMASTON, *Knox Co.* (Pop., 3,017; est., 3,017.) On Georges river, 4 miles west of Rockland. Engaged in ship-building and manufacture of lime.

History.—Supplied in '87 by Camden & Rockland Water Co. Further data included under Rockland.

WATERVILLE and FAIRFIELD. *Kennebec Co.* (Pop., combined, not given; est., 12,000. Waterville, 1,917; est., 7,000. Fairfield, not given; est., 5,000.) Both villages on Kennebec river, and engaged in manufacturing.

History.—Built in '87 by Waterville Water Co., under 20 years' franchise. Engr., H. G. Dennis, New Bedford, Mass. Contr., J. J. Newman, Providence, R. I.

Water Supply.—Messalonskee river, pumping to reservoir.

Pumping Machinery.—Deane Pump, dy. cap., 2,500,000 galls.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 18 miles. *Services*, tarred i. Pipe and specials furnished by McNeal Pipe & Foundry Co. *Taps*, number not given. *Meters*, do. *Hydrants*, Chapman, 75.

Consumption, not given. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Capital stock and bonds, $400,000. Int., 5 %. Ann. rev.: city, $3,000. Hydrant rental $40. No further information given.

Management.—Treas., Weston Lewis. Supt., H. W. Rogers. Other officers not given.

WINTHROP, *Kennebec Co.* (Pop., est., 1,000.) Ten miles west of Augusta. Engaged in manufacturing oil-cloth, blankets and agricultural implements.

History.—Built by village and private subscriptions in '83, for fire protection only.

Water Supply.—Source not given, by gravity and pumping.

Pumping Machinery.—Force pump in factory of Winthrop Mill Co.

Distribution.—*Mains*, c. i. *Hydrants*, Matthews, 10.

Financial.—Cost, $5,000, of which $3,500 was raised by the town, and $1,500 by subscription.

Management.—Chf. Fire Dept., C. A. Wing. Village Clerk, C. O. Relley.

YORK BEACH, *York Co.* (Pop., est., summer, 3,500.)

History.—Built in '88 by York Beach Water Co. Des. Engr., H. E. Evans, York Village.

Water Supply.—Artesian wells, pumping to tank.

Tank.—Cap., 25,000 galls.

Pumping Machinery.—Worthington duplex, dy. cap., 90,000 galls.
Distribution.—*Mains*, galv. i., 3 miles. *Services*, galv. i.
Management.—Supt., H. E. Evans.
No other data given, as works were just started at time of report.

Water-Works Projected with Fair Prospect of Construction.

BUCKSPORT, *Hancock Co.* (Pop. 3,047; est., 3,500.) 18 miles from Bangor. Engaged in ship-building, fishing, farming and tanning.

Proposed System.—The Bucksport Water Co. was chartered in '87, and organized Feb., '88. Prest., Parker Spofford. Secy., O. P. Cunningham. No work had been done the latter part of May, '88, but it was expected that construction would begin soon.

Present Supply.—7 reservoirs, combined cap., 100,000 galls.; used in connection with force pumps for fire protection. Town Clerk, W. A. Remick.

CARIBOU, *Aroostook Co.* (Pop., 2,756; est., 3,500.) On Aroostook river. Engaged in manufacturing and general trade.

Proposed System.—Caribou Water Co. propose to build works, letting contracts Oct. 1, '88, and completing the system Sep. 1, '89. Prest., F. H. Clergue, Bangor. Secy., H. M. Heath, Augusta. Supply to be from Aroostook river, with choice between pumping to stand-pipe and reservoir. Works will include: Dam, 12 ft. high by about 500 ft. long, to be built of wood; 75,000-gall. reservoir with elevation of 180 ft., or 150,000-gall. stand-pipe; 1,000,000-gall. pump; 7,000 ft. 8 in. and 6,000 ft. 6 in. c. i. pipe, and 25 hydrants. Town has already voted $2,000 a year for 25 hydrants, and exemption from taxation, the franchise being for 20 years.

Present Supply.—Four reservoirs for fire protection. Village Clerk, W. C. Spalding.

EASTPORT, *Washington Co.* (Pop., 4,006; est., 5,000.) On Moose island, in Passamaquaddy bay, at mouth of St. Croix river. Summer resort. Engaged in commerce, fishing and canning industries.

Proposed System.—Water-works projected in '87 by local company, Secy. and Treas., N. B. Nutt, and town voted to pay $4,000 for 60 hydrants. The National Water Works Syndicate, Genl. Mgr., B. C. Mudge, 70 Kilby St., Boston, Mass., propose to put in a stand-pipe system in '88, and report: stock, $100,000; bonds, $80,000 at 5 % int.

Present Supply.—13 cisterns and some reservoirs used for fire protection. For further information, address S. D. Leavitt or S. R. Byram.

ELLSWORTH, *Hancock Co.* (Pop., 5,052; est., 6,000.) On Union river, 26 miles from Bangor. Engaged in ship-building and lumber trade.

Proposed System.—The Ellsworth Water Co., Prest., A. W. Cushman, proposes to construct works in '89, water to be pumped from Branch pond to stand-pipe, at a cost of $80,000. Capital not yet secured. Chairman Water Bd., C. C. Burrill.

Present Supply.—13 cisterns filled from river for fire protection.

FARMINGTON, *Franklin Co.* (Pop., 3,353; est., not given.) On Sandy river, 33 miles from Augusta. Engaged somewhat in manufacturing.

Proposed System.—The Farmington Water Co. tried for over a year to contract with town to put in works. The National Water Works Syndicate, Genl. Mgr., B. C. Mudge, 70 Kilby St., Boston, Mass., propose to construct works in '88, pumping system, and report: stock, $100,000; bonds, $60,000.

Present Supply.—Cisterns, wells and brook. Town Clerk, J. W. Merrill.

FORT FAIRFIELD, *Aroostook Co.* (Pop., est., 1,000.) On Aroostook river. Incorp. a village in '87. Village Clerk, N. H. Martin.

Proposed System.—The Sarsfield Water Co., Prest., Jno. B. Trafton, proposed to put in works in '87, but did not. The National Water Works Syndicate, Genl. Mgr., B. C. Mudge, Boston, Mass., now propose to construct the works in '88. Supply: Brook, 2 miles from village, by gravity, with reservoir 150 ft. above village. Stock, $25,000, Bonds, $25,000.

Present Supply.—Wells and river.

MACHIAS, *Washington Co.* (Pop., 2,204; est., 2,300.) On Machias river. Engaged in ship-building and commerce.

Proposed System.—It has been proposed to organize a company to bring water from a lake three miles distant, probably by pumping, at a cost of about $25,000, but nothing definite has been determined. Chairman Bd. Selectmen, Jno. R. Somers. Town Clerk, H. R. Taylor.

Present Supply.—Six reservoirs supplied by springs, brooks and river used for fire protection.

ORONO, *Penobscot Co.* (Pop., 2,245; est., 2,300.) On Penobscot river. Engaged in manufacturing.

Proposed System.—The Orono Water Co. was incorporated, Feb., '87. Prest., Dr. E. N. Mayo. Secy., B. E. Donigan. Water will be taken from Penobscot river, probably by pumping to stand-pipe. The company proposed to build the works in '88, but had not begun Aug. 11.

Present Supply.—For domestic use, wells; for fire protection, 22 cisterns. Town Clerk, Albert White.

SEAL HARBOR, *Hancock Co.* (Pop., est., 400.) A summer resort on Mt. Desert island.

Proposed System.—The Seal Harbor Water Co., Prest., Saml. F. Barr, propose to bring water from Jordan Pond, 2 miles from, and 230 ft. above, village, by gravity, using 8-in. pipe for first 4,000 ft., 6-in. thence to village and 4-in. in village. Works estimated to cost $20,000, money to be raised from proprietors of hotels and cottages by subscription for stock and bonds. J. M. Campbell, of Glencoe Hotel, can give further information.

Present Supply.—Wells.

WALDOBORO, *Lincoln Co.* (Pop., 3,758; est., not given.) At mouth of Medomak river. Engaged in ship-building and general trade.

Proposed System.—The Waldoboro Water Co. was chartered in '87, or early part of '88, but did not organize until Aug. 10, '88. In spring of '88 town voted the company a subsidy of $600 yearly for 10 years. Town Clerk, P. E. Storer.

Present Supply.—River and 5 reservoirs.

YARMOUTH, *Cumberland Co.* (Pop., 2,021; est., 2,500.) On Royals river, 11 miles northeast of Portland. Engaged in manufacturing.

Proposed System.—The Pumgustuck Water Co., Prest., L. Shaw, was organized some time since, but nothing has yet been done. It was proposed to pump water from Royals river to a stand-pipe at a cost of from $30,000 to $50,000.

Present Supply.—Wells and cisterns.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Damariscotta, *Lincoln Co.*; New Castle, *Lincoln Co.*; Newport, *Penobscot Co.*; Tilden, *Hancock Co.*; Waldo, *Waldo Co.*

NEW HAMPSHIRE.

Water-Works Completed or in Process of Construction

BRISTOL, *Grafton Co.*—(Pop., 1,006; est., 1,200.) Engaged in manufacturing.

History.—Built in '86 by Bristol Aqueduct Co. Des. Engrs., Johns & Brewer, Bristol. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Newfound lake, by gravity.

Distribution.—*Mains*, cement, 5 miles. *Services*, rustless i. *Taps*, 69. *Meters*, none. *Hydrants*, kind not given, 32.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $22,000. Stock, $22,000. Debt, withheld. Int., 6 %. Ann. op. exp., $400. Ann. rev.: consumers, $1,000; city, $900. Hydrant rental, $30.

Management.—Prest., B. F. Perkins. Treas. and Genl. Mgr., Geo. M. Covis. Supts., Johns & Brewers.

CLAREMONT, *Sullivan Co.* (Pop., 4,704; est., 5,000.) On Connecticut river. Engaged in manufacturing.

History.—Built in '87-8 by N. W. Ellis & Co., Manchester, N. H., who were Engrs. and Contrs. for the works. Town has a right to purchase the works by appraisal within five years.

Water Supply.—Two brooks, by gravity and direct pumping.

Reservoirs.—Three; cap., 2,750,000, 3,250,000 and 23,000,000 galls., respectively; the latter is a storage reservoir, and will be finished Nov., '88.

Pumping Machinery.—Used a few weeks in summer while storage reservoir is being built; Knowles' direct acting steam pump, No. 10.

Distribution.—*Mains*, cement, Phipps' patent, 8½ miles. *Services*, w. i. and cement. Pipe furnished by New Haven (Conn.) Patent Water Pipe Co. *Taps*, 75. *Meters*, 12. *Hydrants*, Coffin. 42. *Valves*, Coffin.

Consumption, 150,000 galls. *Pressure*: Ordinary, 65 to 104 lbs. Fire, not given.

Financial.—Hydrant rental, $35. No other data given.

Management.—Address, N. W. Ellis & Co., Manchester, N. H.

CONCORD, WEST CONCORD and PENACOOK, *Merrimack Co.* (Pop., Concord, 13,843; est., not given. West Concord, not given. Penacook, est., 2,000.) Concord on both sides Merrimack river, trade and manufacturing center. Settled in 1725; incorp. a city in '53. West Concord, adjoining village. Penacook, six miles from Concord. Engaged in manufacturing.

History.—Built in '72-'3 by city of Concord, and extended to West Concord and Penacook in '87. Engr. of original works, Jos. A. Weston.

Water Supply.—Penacook lake, three miles from, and 37 to 152 ft. above, various parts of city. Area of lake, 265 acres, drainage basin, 3 sq. m.

Dam.—Across outlet of lake, earth, with heart-wall, 3½ ft. wide at bottom, 2 ft. wide at top. Dam 18 ft. high and 250 ft. long.

Conduit.—Elliptical, brick, 24 by 30 ins., extends into lake 1,950 ft. and conveys water to 14-in. w. i. and cement pipe 3½ miles long.

Distribution.—*Mains*, sheet i., cement-lined lead, 41.13 miles. *Services*, w. i. and cement, connected with tin-lined lead. *Taps*, 2,100. *Meters*, 21. *Hydrants*, kind not given. *Valves*, Ludlow and a few Chapman.

Consumption, not given. *Pressure*: Ordinary, 46 lbs. Fire, 46 lbs.

Financial.—Cost, $481,224. Debt., $445,000. Int., 4 to 6 %.

Management.—Six commissioners. Supt., V. C. Hastings.

DOVER, *Stafford Co.* (Pop., 11,687; est., 14,387.) On Cocheco river, which falls 32 ft. at this point, 12 miles from Portsmouth. Engaged in general trade and manfacturing. Settled in 1823, incorp. a city in '55.

History.—Three companies furnished the city with water until recently; the Dover Landing Aqueduct Co., organized in '26; the Cocheco Aqueduct Association, organized in '32; the Dover Aqueduct Co., date of organization not given. The city has purchased the works of the Cocheco Aqueduct Association and has been negotiating for those of the other two companies. New works are being built by city. Engr., Percy M. Blake, Hyde Park, Mass.

Water Supply.—Descriptions of the old supply systems are given in *Engineering News*, Vol. X., p. 423 and Vol. XIX., p. 391. The new system will be in connection with the old Cocheco works, whose supply was from a well fed by springs and from Willand Pond. Two large wells are proposed.

Distribution.—Three systems combined: *Mains*, 20 miles. *Meters*, 25. *Hydrants*, 17.

Financial.—New works to cost about $275,000, Ann. rev.: old systems combined, about $17,000.

NOTE.—See Supplement for description of new works.

DREWSVILLE, *Cheshire Co.* (Pop., est., 90.) Four miles from Bellows' Falls. Notable as being the smallest village in America supplied with water by an organized company.

History.—Supplied by Drewsville Water Co., organized in 1804, and consisting of ten shareholders.

General Description.—Supply: From spring, by gravity through 0.5 miles of bored logs. Some of the logs laid in 1804 are still in use, although most of them were relaid in '76. The water is conveyed to a covered wooden box 2 by 3 ft., by 2 ft. deep. In this box an augur hole is bored for each share of stock and from these holes water is piped to the houses, which are built on the four sides of a commo

The expense of maintenance is divided equally among the shareholders, but the only item of importance was $282.91 spent for relaying the logs and putting a new covering over the wooden box serving as a reservoir.

EXETER, *Rockingham Co.* (Pop., est., 1,500.) On Exeter river. Engaged in cotton and other manufacturing.

History.—Built in '86-7 by Exeter Water Co., under 20 years' franchise. Engrs. and Contrs., Wheeler & Parks, 75 State St., Boston, Mass.

Water Supply.—Large well and stream, pumping to stand-pipe.

Pumping Machinery.—Two return tubular boilers, and two Worthington pumps; dy. cap., 1,000,000 each.

Stand-Pipe.—Made by E. Hodge & Co., East Boston, Mass., 25 ft. diam., 60 ft. high.

Distribution.—*Mains* c. i., 11 miles. *Services*, enam. w. i. Pipes and specials furnished by R. D. Wood & Co., Philadelphia, Pa. Trenching and pipe laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 210. *Meters*, 7. *Hydrants*, Coffin, 51.

Consumption—40,000 galls. *Pressure*: Ordinary, 55 lbs.. Fire, not given.

Financial.—Cost, $140,000. Stock, $90,000. Bonds, $50,000. Int., 5%. Ann. op. exp., $3,550. Ann. rev.: consumers, $1,500; city, $2,000. Hydrant rental, $50.

Management.—Prest., E. C. Eastman. Treas., Elbert Wheeler. Supt., Chas. H. Johnson.

FARMINGTON, *Stafford Co.* (Pop., 3,040; est., 3,040.) On Cocheco river. Has extensive boot and shoe manufactories, Incorp. a town in 1798.

History.—Built by city in '71.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Upright tubular boiler and Knowles pump; dy. cap., not given.

Reservoir.—No description given.

Distribution.—*Mains*, w. i. and cement, c. i. *Services*, w. i. *Taps*, 100. *Meters*, 5. *Hydrants*, Caris Patent, 30:

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, not given, Debt, $8,379. Int., 4%. Ann. op. exp., $750. Ann. rev.: consumers, $1,100. City, none.

Management.—Three engineers or commissioners: C. W. Johnson, J. B. Brown and Supt. Wm. F. Thayer. Clerk, Frank Pearl.

GORHAM, *Coos Co.* (Pop., 1,383; est., 1,600.) On Androscoggin river, in mountainous country. Settled in 1800, incorp. a village in '36.

History.—Built by Alpine Aqueduct Co., in '73. Works designed and constructed by company.

Water Supply.—Springs, by gravity to reservoir, thence by gravity to town.

Reservoir.—At elevation of 130 ft. above village; of brick and cement, 16 by 12 by 4½ ft., cap., 6,500 galls. A new reservoir has been proposed.

Distribution.—*Mains*, originally bored pine logs; replaced in '83 by c. i., 23 miles *Services*, galv. i. *Taps*, 215. *Meters*, none. *Hydrants*, Mathews, 11.

Consumption.—27,000 galls. *Pressure*: Ordinary, 56 lbs. Fire, 56 lbs.

Financial.—Cost, $20,000. Stock, $29,000. No debt. Ann. op. exp., $375. Ann. rev.: consumers, $2,006; city, $165. Hydrant rental, $15.

Management.—Prest., Wm. Noyes. Sec'y, Thos. E. Fisk.

GREAT FALLS, *Stafford Co.* (Pop., 859; est., 6,000.) On Solomon Falls river. One of the largest cotton and woolen manufacturing towns in the State.

History.—Built by Great Falls Manufacturing Co., date not given.

Water Supply.—River, direct pumping, and indirect to reservoir.

Pumping Machinery.—Deane duplex power pump, dy. cap., 1,440,000 galls.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, tarred c. i., length not given. *Services*, lead. *Taps and Meters*, not given. *Hydrants*, Chapman, 26.

Consumption, 300,000 galls. *Pressure*: Ordinary, 65 lbs, at pump. Fire, do.

Financial.—No data given.

Management.—Treas., J. Howard Nichols, Boston, Mass. Supt., H. S. Chase.

HANOVER, *Grafton Co.* (Pop., 800; est., 1,000.) On plain ½ mile east of, and from 125 to 175 above, Connecticut river. Divided in two parts by rocky ridge about 100 ft. high. Settled under charter granted in 1761.

History. Built by Hanover Aqueduct Co. in '20.

Water Supply.—Springs collected in 5 wells, by gravity. Springs located on wooded hillside. Wells are from 4 to 6 ft. in diam, and 8 to 12 ft. deep, the lowest being 60 ft. above village.

Conduit.—From wells to village, conduit was from '21 to '57, of bored pine logs; '29 to '80, 1½-in. lead pipe; replaced in '80 by 2-in. lead pipe. In first 1,000 ft. conduit descends 60 ft., then crosses brook in wooden box laid on granite bed of stream and weighted with boulders. Conduit is seldom submerged, but though temperature is sometimes 35° below zero, water in the pipe has never frozen. Near village conduit passes through a hollow under 110 ft. head. Weight of pipe is: Under 60-ft. head, 7 lbs. per ft.; 60 to 80 ft. head, 8 lbs; 80 to 110 ft. head, 9 lbs.

Distribution.—*Mains*, lead, 2 miles. *Services*, lead. *Taps*, 150. *Meters*, none, *Hydrants*, none. Water is delivered to consumers through copper gauge butts perforated with a hole the size of an ordinary needle. These are intended to deliver 40 galls. per day.

Consumption, 10,000 galls. *Pressure*: Ordinary, 50 to 100 ft, head. Fire, none.

Financial.—Cost, $12.000. Stock, $10,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,200 from 150 families; city, none.

Management.—Three directors and president, Prest. and Supt., F. Chase.

HILLSBOROUGH BRIDGE, *Hillsborough Co.* (Pop., 2,000; est., 2,000. Engaged in manufacturing, lumbering and general trade.

History.—Built in '87 by Hillsborough Water Co. Engrs. and Contrs., Goodhue & Birnie, Springfield Mass.

Water Supply.—Loon Pond, area, 600 acres, by gravity.

Distribution.—*Mains*, w. i. and cement, 7 miles. No more data given.

Financial.—Cost, $50,000. Debt., $25,000. Int., 5%. Ann. op. exp., not given. Ann. rev: consumers, not given; city, $1,000.

Management.—Prest., Jno. C. Campbell.

HINSDALE, *Cheshire Co.* (Pop., 1,868; est., 2,000.) On Ashuelot river. Engaged in manufacturing woolen goods, paper, hardware and wooden ware.

History.—A fire protection system owned by village, pipe laid in '84, '85 and '86.

Water Supply.—Canal, by means of 4 force pumps in mills.

Distribution.—*Mains*, 4-in. iron, 1½ miles. *Hydrants*, kind not given, 19.

Management.—Chf. Engr. Fire Dept., S. H. Esten,

KEENE, *Cheshire Co.* (Pop., 6,784; est., 8,000.) On Ashuelot river. Engaged in manufacturing. Settled in 1753; incorp. a city in '74.

History.—Built by town in '69, and enlarged in '88. Engrs., Phineas Ball and Jno. Humphrey.

Water Supply.—Small ponds, by gravity.

Distribution.—*Mains*, w. i. and cement pipe and c. i., 30 miles. *Services*, w. i. *Taps*, 1,187. *Meters*, none. *Hydrants*, Worcester and Humphrey, flush, and Mathews, post, 138. *Valves*, Ludlow, Eddy, Chapman.

Consumption, not given. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $211,096. Debt, 134,000, as follows: $37,000 at 3½%; $35,000 at 5%; $62,000 at 6%. Since '80 debt has been reduced $16,000. Ann. op. exp., $1,292. Ann. rev.: consumers, $12,917.

Management.—Three commissioners. Supt., D. H. Sawyer.

LACONIA and LAKE VILLAGE, *Belknap Co.* (Pop., Laconia, est., 6,000; Lake Village, est., 3,000.) Villages close together, at outlet of Lake Winnipiseogee and both engaged in manufacturing.

History.—Built in '85 by Laconia and Lake Village Water-Works Co. Engrs. and Contrs., N. W. Ellis & Co., Manchester. Sub.-Contrs. for masonry and buildings, G. Cook & Son., Laconia.

Water Supply.—Lake Winnipiseogee, pumping to reservoir.

Pumping Machinery.—Horizontal tubular boiler. Blake duplex pump, dy. cap., 1,000,000 galls.

Reservoir.—Cap., 2,750,000 galls.

Distribution.—*Mains*, w. i., and cement, 13 miles. *Services*, iron. *Taps*, 520. *Meters*, 10. *Hydrants*, Coffin, 78. *Valves*, Coffin.

Consumption, 340,000 galls. *Pressure*, Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $89,000. Stock, $60,000. Bonds, $25,000. Int., 5 %. Ann. op. exp., $3,500. Ann. rev.: consumers, $5,700; city, $2,600. Hydrant rental, $30.

Management.—Prest., J. C. Moulton, Laconia. Treas., Edmund Little, Laconia. Supt., E. L. Cheney, Lake Village.

LAKE VILLAGE, *Belknap Co.* See Laconia and Lake Village.

LANCASTER, *Coos Co.* (Pop., est., 1,500.) On Israel's river, near Connecticut river. Engaged somewhat in manufacturing.

History.—For domestic use, built by Lancaster Aqueduct Co., date not given. For fire protection, built by fire wards, date not given.

Water Supply.—For domestic use, springs, 3 miles distant, by gravity. For fire protection in business portion, river, through 4-in. iron pipe by pumping.

Pumping Machinery.—Force pump, driven by water-wheel in grist mill.

Distribution.—*Mains*, c. i., 31 miles. *Services*, iron. *Taps*, 100. *Meters*, 0. *Hydrants*, kind not given, 6.

Consumption, not given. *Pressure*: not given.

Financial.—Cost, $2,500. Ann. rev.: consumers, $1,100. No other data given.

Management.—Treas, C. E. Allen. Fire protection system in charge of the fire wards.

LEBANON, *Grafton Co.* (Pop., est., 3,000.) Engaged somewhat in manufacturing.

History.—Built in '87-8 by village. Engr., W. H. Lang, Burlington, Vt. Contrs., W. H. Lang, Goodhue & Co., Burlington, Vt., who furnished all material.

Water Supply.—Mascoma river, pumping to reservoir.

Pumping Machinery.—Lang triplex plunger pump, dy. cap., 1,000,000 galls.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 5.53 miles. *Services*, enam. i. *Taps*, 80. *Meters*, none. *Hydrants*, 52.

Consumption, not given. *Pressure*: Ordinary, 115 lbs. Fire, 115 lbs.

Financial.—Cost, $40,000. Bonds, $40,000. Int., 4½ %. No other data given.

Management.—Supt., H. P. Goodrich.

LISBON, *Grafton Co.* (Pop., 772; est., 1,200.) Engaged in manufacturing.

History.—Built in '86 by N. W. Ellis & Co., Manchester. Des. Engr., N. W. Ellis. Const. Engr., Jno. P. Young, Manchester. Contrs., N. W. Ellis & Co.

Water Supply.—Pearl Lake, by gravity.

Distribution.—*Mains*, w. i. and cement, 4 miles. *Services*, w. i. *Taps*, 60. *Meters*, none, *Hydrants*, Coffin, 31. *Valves*, Coffin.

Consumption, est., 1,000,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $25,000. Debt and int., not given. Ann. op. exp., not given. Ann. rev.: consumers, $600; city, $775. Hydrant rental, $25.

Management.—Private company. Supt., L. C. Payne.

MANCHESTER, *Hillsborough Co.* (Pop., 32,630; est., 41,000.) On Merrimac river, there being a fall of 55 ft. in the river at this point. Largely engaged in manufacturing cotton and woolen goods, locomotives and fire engines. Settled in 1722, incorp. as town of Derryfield in 1751, name changed to Manchester in 1810, incorp. a city in '46.

History.—Built by city in '72-4 when population was 25,000. Engr., Jno. T. Fanning, Minneapolis, Minn. Built mostly by day's work under direction of city.

Water Supply.—Lake Massabesic, by pumping to reservoir.

Dam.—An outlet of lake. Of earth, with heart-wall of grouted rubble masonry. Overfall of dam, stone masonry, 100 ft. long, 24 ft. high above apron. Has stepped face to break falling water.

Penstock.—A canal 15 ft. below overfall and 1,470 ft. long conveys water to penstock 6 ft. in diam. and 600 ft. long, leading to wheels. Penstock made of staves of Georgia pine hooped with iron, and its lower part sustains a pressure of 40 ft. head.

Pumping Machinery.—One Wood pump with two pairs of buckets and 4 plungers, having 16-in. cylinders, 11¼-in. plungers with 40-in. stroke; driven by two 36-in. Jonval turbines working under 45 ft. head, and lifting water 113 ft. to reservoir. In '87 two new Risdon water-wheels 175 H. P. each, were put in by T. H. Risdon & Co. Also Davidson pump with two 24-in. horizontal plungers; dy. cap., 5,000,000 galls. Combined pumping capacity, 11,000,000 galls.

Reservoir-Conduit.—Cement-lined w. i., with c. i. hubs and lead joints, 6,752 ft. of 20-in. pipe.

Reservoir.—475 by 275 ft., by 23 ft. deep, cap., 15,000,000 galls. Built by excavation and embankment, slopes lined with concrete. Surface is 152 ft. above city hall and 188 ft. above depot.

Distribution.—*Mains*, 49½ miles. Originally w. i. and cement, but since '76 of c. i. In the four years, '77 to '80, there were 745 leaks in the cement-lined w. i., and but 85 in the c. i., pipe. In '77 a leak was found where a 12-in. main crossed a river. It was in the spigot end of a length, close to the bell, 5 in. long by ⅛ in. wide. While repairing it, a sand and water jet wore out a piece of iron 8 in. sq. and 1 in. thick in 48 hours. *Services*, enam. i. *Taps*, 3,100. *Meters*, 750. *Hydrants*, Coffin and Pattee, 418. *Gates*, Coffin and Ludlow.

Consumption, 1,750,000 galls. *Pressure*: Ordinary, 62 lbs. Fire, 62 lbs.

Financial.—Cost, $901,273. Debt, $600. Int., 4 and 6 %. Ann. op. exp., $15,169. Ann. rev.: consumers, $58,777 ; city, $22,450.

Management.—Five Commissioners and Mayor. Supt., Chas. K. Walker. Registrar, Arthur E. Stearns.

MILFORD, *Hillsborough Co.* (Pop., 2,398; est., 3,000.) Summer resort and manufacturing village.

History.—A small fire protection system was constructed in '82. The Milford Water Co. have contracted with the town to have works in operation by Dec. 1, '88. the town having the privilege of buying the works at cost, and 5 % bonus, with interest, prior to Dec. 1, '89, or any time within ten years, at appraisal.

Proposed System.—Water to be pumped from Clark's brook to stand-pipe on Gibson's hill, the company to furnish 40 hydrants at $35 each per annum for ten years. Prest. of company, Wm. M. Knowlton.

NASHUA, *Hillsborough Co.* (Pop., 13,397 ; est., 18,000.) On Nashua river near its junction with Merrimack river. A manufacturing city. Incorp. in '53.

History.—Built in '55 by Pennichuck Water-Works Co.

Water Supply.—Pennichuck brook, 1½ miles from city, by direct pumping and pumping to reservoir. The brook flows from Long Pond, west of the city, with rapid descent to the Merrimack river, furnishing five water powers, all owned by the company, with dams at three. No manufacturing is allowed on the stream.

Pumping Machinery.—Horizontal tubular boiler. One Worthington pump, dy. cap., 3,000,000 galls. Two Lang water-power pumps, combined dy. cap., 4,500,000. Total pumping cap., 7,500,000. One Lang pump is located at the middle dam and driven by two small Swain turbines. The other, at lower dam, is driven by a Jonval turbine. Steam pumps used only about three months of year.

Reservoir.—Cap., 4,000,000 galls.

Distribution.—*Mains*, c. i., 35 miles. *Services*, lead and galv. i. *Taps*, 2,500, *Meters*, 25. *Hydrants*, Chapman, 75. *Valves*, Chapman.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Stock, $250,000. Other data withheld.

Management.—Prest., Edw. Spalding. Treas., Harry M. Hobson. Supt., H. G Holden.

NORTH CONWAY, *Carroll Co.* (Pop., 553 ; est., 800).

History.—Built in '33. Now owned by North Conway Water Co.

Water Supply.—Artist's brook, by gravity.

Distribution.—*Mains*, tarred c. i., 8 miles, bought of R. D. Wood & Co., Philadelphia, Pa. *Services*, tarred w. i. *Taps*, 85. *Meters*, none. *Hydrants*, 6, bought of R. D. Wood & Co. *Valves*, kind, do.

Consumption, not given. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, 20,000. Stock, $20,000. No debt. No more data given.

Management.—Prest., W. M. Pitman. Secy., Treas. and Supt., Lycurgus. Pitman.

NORTHFIELD, *Merrimack Co.* (Pop., est., 2,000.) Village is partly in town of Northfield and partly in Tilton.

History.—The Tilton & Northfield Aqueduct Co. are constructing works and hope to finish by Sept., '88. Company doing the work with S. J. Winslow as agent for construction.

Water Supply.—Knowles' Lake, 300 ft. above village, by gravity.

Financial.—Cost, est., $30,000 to $50,000.

NOTE.—No other data given in time for insertion here. See Supplement.

PETERSBOROUGH, *Hillsborough Co.* (Pop., 2,206; est., 2,300.) On Contocook river. Engaged in manufacturing cotton and woolen good and shoes.

History.—A small fire protection system built by town, date not given.

General Description.—Three small pumps and street mains used in connection with 15 hydrants. Supt. Jno. H. Steele.

PITTSFIELD, *Merrimack Co.* (Pop., 1,184; est., 2,000.)

History.—Built in '84 by Pittsfield Aqueduct Co. Des. Engrs., A. Whittemore, Jr., and S. J. Winslow. Const. Engr., N. W. Ellis, Manchester. Contrs., Connecticut Patent Water Pipe Co., New Haven, Conn.

Water Supply.—Berry Pond, by gravity to reservoir, and thence to village. Pond is 2½ miles from and 400 ft. above main street of village.

Reservoir.—For distribution, in ravine lower than pond; cap., 1,500,000 galls.

Distribution.—*Mains*, w. i. and cement, 6¾ miles. *Services*, w. i. *Taps*, 300. *Meters*, 1. *Hydrants*, Ludlow, 27. *Valves*, Bigelow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $33,000. Stock, $40,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $3,000; city, $945. Hydrant rental, $35, and exemption from taxation for ten years.

Management.—Prest., R. L. French. Treas., Jno. A. Goss. Supt., S. J. Winslow.

PLYMOUTH, *Grafton Co.* (Pop., 1,719; est., 2,000.) On Pemigewasset river. Engaged in manufacturing.

History.—Built in '81 by Plymouth Aqueduct and Water Co. Des. Eng., Chas. Lund. Const. Engr., W. F. Langdon. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Springs, by gravity, water being collected in two small reservoirs.

Reservoirs.—Area, ½ and ⅔ acres, respectively.

Distribution.—*Mains*, cement-lined iron, 3.3 miles. *Services*, tarred w. i. *Taps*, 130. *Meters*, 1. *Hydrants*, Perkins, 27.

Consumption, 50,000 galls. *Pressure*: Ordinary, 76 lbs. Fire, 76 lbs.

Financial.—Cost, $40,000. Stock, $20,000. Debt, $20,000. Int., 5%. Ann. op. exp., $200. Ann. rev.: consumers, $1,800. city, $675. Hydrant rental, $25, fire wards keeping hydrants in repair.

Management.—Prest., Alvin Burleigh. Treas., Jno. Mason. Supt., W. F. Langdon.

PORTSMOUTH, *Rockingham Co.* (Pop., 9,690; est., 11,000.) On Piscataqua river. Engaged in manufacturing, ship-building and commerce, being the only seaport town in the State.

History.—Built in 1798 by Portsmouth Aqueduct Co., which was incorp. Dec. 19, 1797. A new company has been incorp. with powers to take the property of the old one and construct a modern system.

Water Supply.—Springs, by gravity and pumping, a small pump having recently been put in.

Distribution.—*Mains*, wooden logs, length not given. It is stated that in making repairs some of the original logs were found with the 2-in. bore to 3 in. worn by the flow of water.

No more data given. City Clerk, Mercer Goodrich.

ROCHESTER, *Stafford Co.* (Pop., 4,683; est., 5,000.) Manufacturing town.

History.—Built in '85 by Rochester Aqueduct and Water Co. Des. Engr., M. M. Tidd, Boston, Mass. Const. Engr., J. A. Farrington.

Water Supply.—Brook, 4 miles from town, by gravity to reservoir and thence to town.

Reservoir and Dam.—Water is led to reservoir, or pond, by a canal. Area of reservoir, about 50 acres; depth, 28 ft. Dam across outlet was built by a Mr. Shannahan, Portland, Me.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. Pipe furnished by A. H. McNeal, Burlington, N. J., and laid by Inman Bros., New York. *Taps*, 150. *Meters*, 1. *Hydrants*, Coffin, 52. *Valves*, Coffin.

Consumption, unknown. *Pressure*: Ordinary, 68 lbs. Fire, 68 lbs.

Financial.—Cost, $100,000. Stock, $100,000. No debt. Ann. op. exp., $1,700. Ann rev.: consumers, $2,950; city, $2,600. Hydrant rental, $50.

Management.—Prest., Frank Jones. Treas., Albert Wallace. Supt., J. Greenfield.

WOODSVILLE, *Grafton Co.* (Pop., 402; est., 800.)

History.—Built in '86 by Woodsville Aqueduct Co., and being extended in '88. Engr., W. H. Lang, Burlington, Vt. Contrs. for all labor and material, W. H. Lang, Goodhue & Co., Burlington, Vt.

Water Supply.—Ammanoosuc river, direct pumping.'

Pumping Machinery.—Lang pump, dy. cap., 1,500,000 galls.

Distribtiuon.—*Mains*, iron, 3½ miles. *Services*, iron. *Taps*, 133. *Meters*, none. *Hydrants*, 19.

Consumption, 80,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 100 lbs., or more.

Financial.—Cost, $30,000, covered by stock and bonds, amount of each not given. Ann. op. exp., $375. Ann. rev.: consumers and precinct, $2,400. Hydrant rental, $20.

Water-Works Projected with Fair Prospects of Construction.

NEWPORT, *Sullivan Co.* (Pop., 2,612; est., not given.) On Sugar river. Engaged in manufacturing.

Proposed System.—A charter was granted in '87 to Dexter Richard and Frederick W. Lewis. It is proposed to take water from Sunapee lake, by gravity, to a distribution reservoir near village. The pipe line, six miles in length, has been surveyed. Est. cost, $50,000. Capital for construction to be raised by subscription for stock.

Present Supply.—None, except from river and three small reservoirs, for fire protection.

WOLFBOROUGH, *Carroll Co.* (Pop., 2,222; est., 3,000.)

Proposed System.—The Wolfboro Water Co., Prest., Stephen Durgin, Engr., J. A. Farrington, propose to construct a gravity system, taking the supply from Beach pond. Est. cost., $40,000, but no capital for construction had been secured the latter part of June, '88.

Present Supply.—No system; water taken from lake, river and wells. Town Clerk, C. J. Frost.

Water-Works Projects Reported in '87 and '88 but Now Indefinite.

The Weirs. *Belknap Co.*

VERMONT.

Water-Works Completed or in Process of Construction

BARRE, *Washington Co.* (Pop., 2,060: est., 5,000.) Has large granite quarries.

History.—Being built in '88 by Barre Water Co. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Stevens branch of Winooski river, by gravity.

Distribution.—*Mains*, iron, 11 miles.

Management.—Prest., J. Henry Jackson. Secy., Edw. W. Bisbee. Treas., Wm. Goodhue. No other data given, as works are in progress.

BELLOWS FALLS, *Windham Co.* (Pop., 2,229: est., 3,000.) On Connecticut river has good water-power and is engaged in paper and other manufacturing. Incorp. a village in '33.

History.—Built by village in '48. Engr., unknown.

Water Supply.—Lake Minard, 300 ft. above village, by gravity. Lake has area of 75 acres and is fed by springs.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead and w. i. *Families supplied*, 600. *Meters*, 6. *Hydrants*, R. D. Wood & Co.'s, 50. *Valves*, Ludlow. *Consumption*, not given. *Pressure*: Ordinary, 127 lbs. Fire, 127 lbs.

Financial.—Cost, $60,000. Debt, $41,900. Int., one half at 5%, one half, 6%. Ann. op. exp., $750. Ann. rev: consumers, $6,000; city, $1,350.

Management.—Commrs., Wm. A. Miller, S. S. Coolidge, F. S. Howe. Treas., C. E. Howard.

BENNINGTON, *Bennington Co.* (Pop., est., 5,000.) Engaged in manufacturing.

History.—Built in '85-7 by Bennington Water Co. Engrs.; and Contrs., not given.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 200. *Meters*, 3. *Hydrants*, Ludlow, 33. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 130 lbs. Fire, 130 lbs.

Financial.—Cost, $60,000. Stock, $60,000. Debt, $48,000. Int., 5%. Ann. rev.: city 1,000. Hydrant rental, $33.33. Other data not given.

Management.—Prest., Henry W. Putnam. V. Prest., Treas. and Supt., E. H. Putnam. Sec., Jno. T. Shurtleff.

BRANDON, *Rutland Co.* (Pop., 3,280; est., not given.) On Otter creek. Engaged in quarrying, and general trade. Settled in 1774, and incorp. as a fire district.

History.—Built in '79 by fire district. Des. Engr., Thos, Ross. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Hitchcock's pond, by gravity. Pond located in mountains, 5½ miles from, and 150 to 180 ft. above, village; area, ⅛ sq. m.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv i. *Taps*, 225. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 35.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $40,000. Debt, $36,000. Int., 4%. Ann. op. exp., $200. Ann. rev.: consumers, $2,000; city, none.

Management.—Prudential Committee: Chairman, C. W. Briggs. Supt., H. Roberts.

BRATTLEBORO. *Windham Co.* (Pop., 4,471; est., 6,500.) On Connecticut river. Engaged in manufacturing.

History.—Built in '84 by Geo. E. Crowell, who owns works.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 7,500,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 5. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $100,000. Debt, none. Ann. op. exp., not given. Ann. rev.: consumers, $3,000; city, $250. Hydrant rental, $50.

Management.—By owner. Supt., W. E. Eason.

BURLINGTON, *Chittenden Co.* (Pop., 11,365; est., 14,000.) On Lake Champlain, on ground rising gradually from the lake to an elevation of over 300 ft. Has large cotton, woolen, marble, and all kinds of lumber, manufactories, and large lumber trade, especially by water. Settled in 1773; incorp. a city in '65.

History.—Built by city in '67. Engr., Wm. S. Whitwell.

Water Supply.—Lake Champlain, pumping to reservoir.

Reservoirs.—Low service: earthwork formed by excavation and embankment; 280 ft. above lake; 200 ft. sq. by 13 ft. deep. Cap., 2,360,000 galls. High service: iron tank, about 300 ft. above lake; cap., 106,000. A new 3,000,000-gall. reservoir is being built close by, and to connect with, the one now used for low service. Contrs., W. H. Lang, Goodhue & Co.

Pumping Machinery.—Two Worthington duplex pumps, dy. cap., 750,000 galls. each.

Buildings.—Brick pump-house and boiler-room; also coal-shed.

Distribution.—*Mains*, w. i. and cement, and c. i., 29.58 miles. *Services*, lead and galv. i. *Taps*, 2,240. *Meters*, 374. *Hydrants*, 162.

Consumption, 16,743 galls. *Pressure*: Ordinary, 75 to 85 lbs. Fire, 75 to 85 lbs.

Financial.—Cost, $324,351. Debt, $231,500. Int., 4 and 6 %. Sinking fund, $97,850. Ann. op. exp., $13,200. Ann. rev.: consumers, $29,066; city, $1,594. Hydrant rental, $1,200 a year, regardless of number.

Management.—Three Commrs. chosen from Board of Aldermen. Supt., F. H. Crandall.

FAIRHAVEN, *Rutland Co.* (Pop., 2,211; est., 3,000.) On Castleton river. Has marble and slate quarries. Settled in 1779; incorp. a village in '20.

History.—Built in '80 by village. Des. Engr., J. J. R. Randall, Rutland. Const. Engr., O. A. Peck, Fair Haven.

Water Supply.—Inman pond, by gravity. Pond has area of 80 acres, but very small drainage area, being fed by springs; 3.4 miles from, and 200 ft. above, village.

Tunnel.—Water taken from pond through a rock tunnel 150 ft. long and 35 ft. below surface of land adjoining pond.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, kind not given, 27.

Consumption, 40,000 galls. *Pressure*: Ordinary, 190 lbs. Fire, 190 lbs.

Financial.—Cost, $36,000. Debt, in '85, $35,000. Int., 5 %. Ann. op. exp., $400. Ann. rev.: consumers, $3,500; city, none.

Management.—Three Commrs. Supt., O. A. Peck.

HYDE PARK, *Lamoille Co.* (Pop., 331; est., 500.) On Lamoille river. Settled in 1790; never incorp.

History.—Small system for domestic supply built in '50 by Hyde Park Water Co., but now owned by C. S. Page.

Water Supply.—Springs, by gravity and pumping.

Pumping Machinery.—Curtis double acting pump, cap., 1,700 galls. per hour, driven by windmill.

Distribution.—*Mains*, iron and lead, 2 miles. *Services*, lead. *Taps*, 45. *Meters and hydrants*, none.

Consumption, 7,000 galls. *Pressure*: Very small.

Financial.—Cost, $3,500. Debt, none. Ann. op. exp., $150. Ann. rev.: consumers, $450. Hydrant rental, none.

Management.—Treas. and Gen. Mgr., E. S. Page. Supt., Isaac C. Vaughan.

ISLAND POND, *Essex Co.* (Pop., 300; est., 2,000.) Engaged in lumbering.

History.—Built in '79 by Island Pond Aqueduct Co.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i. and lead, 3 miles. *Services*, lead. *Taps*, 60. *Meters*, none. *Hydrants*, R. D. Wood & Co. 5.

Consumption, 30,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $12,000. Debt, none. Ann. op. exp., $120. Ann. rev.: consumers, $1,050; city, $50. Hydrant rental, $5.

Management. Prest., Secy. and Treas., G. W. Noyes.

MONTPELIER, *Washington Co.* (Pop., 1,847; est., 3,220.) On Winooski river, in hilly country. Settled in 1787, incorp. a village in '18.

History.—*First Supply*: Furnished in '20 by John E. Hubbard for domestic use Water is taken from springs in surrounding hills and conveyed to village in lead and c. i. pipes, the latter being added in '84, and connected with a small reservoir. There are 8½ miles of pipe and 185 taps; the pipe sustains a pressure of 82 lbs. The cost of the system is unknown. J. E. Hubbard, grandson of the former owner, now owns and controls the system. A full and interesting description of the construction and extension of these works was given in *Eng. News*, Vol. XV., pp. 331-2. *Village System*: Built in '84. Engr., Joel Foster.

Water Supply.—Berlin pond, by gravity. Pond has area of one sq. m.

Reservoir.—A mile below pond a rubble masonry and cement dam, 14 ft. high by 25 ft. long, forms a 4,250,000 gall. reservoir which is 364 ft. above village.

Distribution.—*Mains*, c. i. and w. i., 12 43 miles. *Services*, w. i. Cast-iron pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. Trenching done by L. F. Malloy and pipe laying by village. *Taps*, 391. *Meters*, 4. *Hydrants*, Ludlow, 54.

Consumption, 900,000 galls. *Pressure*: Ordinary, 156 lbs. Fire, 156 lbs.

Financial.—Cost, $70,000. Debt, $50,000. Int., 4½ %. Ann. op. exp., $2,535. Ann. rev.: consumers, $4,580; city, $1,720. Hydrant rental, $30.

Management.—Five Commrs. Supt., Joel Foster.

NEWPORT, *Orleans Co.* (Pop., 920; est., 2,000.) On Lake Memphremagog. Summer resort and manufacturing village.

History.—Built by city in '85. Engrs. and Contrs., Geo. F. Blake Manufacturing Co., New York City.

Water Supply.—Lake Memphremagog, direct pumping.

Pumping Machinery.—Knowles, dy. cap., 400,000 galls.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Chapman, 17. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—Cost, $60,000. Debt, none. Ann. op. exp., $250. Ann. rev.: consumers, $600; city, none.

Management.—Operated by Prouty & Miller.

NORTHFIELD, *Washington Co.* (Pop., 1,313; est., 2,000.) Has slate quarries.

History.—Built in '54 by private companies and sold since to Northfield Aqueduct Co.; improvements completed in '86. Engrs. and Contrs., not given. A project for new works to be built by the town is reported.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, 5 miles. *Services*, iron. *Taps*, 80. *Meters*, none. No hydrants, but water is stored in 7 reservoirs for fire protection.

Consumption, unknown. *Pressure*: 300 ft. head.

Financial.—Cost, present company bought the works for $10,000, said to be one-fourth the original cost. $36,000. Debt, none. Ann. op. exp., $100. Ann. rev.: consumers, $870; city, not given. Hydrant rental, not given.

Management.—Prest., Amos Plastridge. Treas. and Clerk, Ira Beard. Supt., Wm. M. Davis.

RUTLAND, *Rutland Co.* (Pop., 7,502; est., 10,000.) On East creek, near Otter creek. Has large marble quarries; engaged in manufacturing.

History.—Built in '56 by village.

Water Supply.—Mendon river, by gravity.

Reservoirs.—Two settling and a distributing reservoir. The water passes from the river through an old water course to a settling reservoir, 100 by 50 ft., by 4 ft. deep, and thence through a bed of gravel to another settling reservoir, 200 by 80 ft., by 9 ft. deep. From here a 12-in. c. i. pipe conveys the water to a gallery 150 ft. long, into which the first supply was to filter from East creek. From the gallery 3½ miles of 12 and 6-in. c. i. pipes lead to the 1,000,000-gall. distributing reservoir at the village.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i. *Taps*, 1,050. *Meters* none. *Hydrants*, Mathews, 60.*

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $100,000. Debt, $67,500. Int., 4½ and 5 %. Ann. op. exp., $3,000. Ann. rev.: consumers, $17,000; city, none.

Management.—Commrs., W. C. Landon, J. M. Davis, N. L. Davis. Supt., J. M. Davis.

ST. ALBANS, *Franklin Co.* (Pop., 7,193; est., 7,500.) Butter market for northern Vermont. Incorp. a village in '59.

History.—Built in '73 by village. Engr., Jno. T. Fanning.

Water Supply.—Surface water, by gravity. Drainage area, 3 sq. m.

Reservoir.—Dam across small stream makes a pond covering 28 acres; cap., 100,000,000 galls.; 336 ft. above town.

Dam.—Of earth, 400 ft. long, 28 ft. high, 20 ft. wide on top; inner slope, 2½ to 1; outer, 1½ to 1. Also an embankment extending 1,950 ft. across low ground.

Distribution.—*Mains*, w. i. and cement, 14 miles. *Services*, galv. i. *Taps*, 815. *Meters*, none. *Hydrants*, Whittier Machine Co.'s and Perkins, 54. *Gates*, Eddy and Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Cost, $175,000. Debt, $150,000. Sinking fund, $40,000. Int., 5 %. Ann. op. exp., $1,516. Ann. rev.: consumers, $7,224; city, none.

Management.—Board of Fire Trustees with Clerk and Treas., not given. Supt., Marshall Mason.

ST. JOHNSBURY, *Caledonia Co.*—(Pop., 3,360; est., 6,000.) On Passumpsic river, in hilly region. Engaged in manufacturing. Settled in 1787; incorp. a village in '52.

History.—Built in '76 by village. Engr., J. P. Flanders. Contrs., Vergennes Machine Co., of Vergennes, now out of business.

Water Supply.—Passumpsic river, direct pumping.

Dam.—Timber, furnishes water-power to drive pump.

Pumping Machinery.—Flanders, dy. cap., 2,500,000 galls. Water passes to pump through gravel filter 4 ft. deep, which is reported to give satisfaction.

Distribution.—*Mains*, iron, 8 miles. *Services*, galv. i. *Taps* (in '86) 333. *Meters*, none. *Hydrants*, Pattee & Perkins, 78.

Consumption, 500,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 112 lbs.

Financial.—Cost, $80,000. Debt, $62,500. Int., 4 and 4½ %. Ann. op. exp., $1,000. Ann. rev.: consumers, $4,448; city, none.

Management.—Supt., Chas. A. Calderwood.

SPRINGFIELD, *Windsor Co.* (Pop., 1,589; est., 3,300.) On Connecticut and Black rivers. Engaged in manufacturing.

History.—Built for domestic supply in '84 by Springfield Village Water Supply Co.

Water Supply.—Springs, at an elevation of 150 ft., by gravity.

Distribution.—*Mains*, lead, ½ mile. *Services*, lead. *Taps*, 25.

Consumption, 4,800 galls. *Pressure*: not given.

Financial.—Cost, $2,000. No debt. Ann. op. exp., nominal. Ann. rev.: consumers, $250.

Management.—Owned and operated by Albert Brown.

SWANTON, *Franklin Co.* (Pop., 3,079.) On Missisquoi river.

History.—Built in '87 by Swanton Water-Works Co., who acted as a construction company. The village to take the works in two years, at cost. Engr., W. H. Lang, Burlington. Contrs., W. H. Lang, Goodhue & Co., Burlington, who furnished all material.

Water Supply.—Missisquoi river, direct pumping.

Pumping Machinery.—Lang triplex pump, driven by Hercules turbine. Cap., 1,000,000 galls.

Distribution.—*Mains*, Wyckoff wood, 3 miles. *Services*, iron. *Taps*, 100. *Meters*, none. *Hydrants*, Lang, 30. *Valves*, Lang.

Consumption, 200,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 110 lbs.

Financial.—Cost, $20,000. The constructing company advanced $15,000, for which the town pays 5 and 6 %. Ann. op. exp., $250. Ann. rev.: consumers, $1,300; city, none.

Management.—Company consists of F. Tarble, Henry M. Stone, and E. W. Jewett.

VERGENNES, *Chittenden Co.* (Pop., 1,782; est., 1,800.) On Otter creek. Has some manufactories. Settled in 1766; incorp. a city in 1788.

History.—Built in '69 by city.

Water Supply.—Otter creek, direct pumping, the water first being filtered through sand and gravel.

Pumping Machinery.—Two Flanders piston pumps built by Vergennes Machine Co. (now out of business) and driven by water-power; cap., not given.

Distribution.—*Mains*, c. i., 6 miles. *Services*, iron. *Taps*, 300. *Meters*, none. *Hydrants*, Lang, 33. *Valves*, Eddy.

Consumption, 90,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $75,000. Debt, $58,000. Int., 4 and 6 %. Ann. op. exp., $1,073. Ann. rev.: consumers $2,900; city, none.

Management.—Three Commrs. Chairman, S. D. Miner.

WATERBURY, *Washington Co.* (Pop., 756; est., 1,500.)

History.—Built in '79 by Warren & Somerville after designs by C. C. Warren.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 2.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—No data given.

Management.—Supt., C. C. Warren.

WEST RANDOLPH, *Orange Co.* (Pop., 1,069; est., 1,500.) Engaged in manufacturing.

History.—Built in '78 by village. Engr., Joel Foster, Montpelier. Work done by village.

Water Supply.—Springs and brooks, 2½ miles from village, by gravity.

Reservoir.—Cap., 1,000,000 galls.: ½ mile from, and 213 ft. above, village.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, tarred w. i. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 140. *Meters*, none. *Hydrants*, Ludlow, 34. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 105 lbs. Fire, 105 lbs.

Financial.—Cost, $22,000. Debt, none. Ann. op. exp., $300. Ann. rev.: consumers, $1,200; city, $510. Hydrant rental, $15.

Management.—Fire Commrs.: Chairman, Wm. H. DuBois. Supt., Lemuel Richmond.

WINDSOR, *Windsor Co.* (Pop., 2,175; est., 2,200.) On Connecticut river. Center for agricultural and dairy trade.

History.—*Old Supply*: A small gravity system was built in '50 by Windsor Aqueduct Co., the supply being taken from Dudley brook. Iron, cement and lead pipe were used, and the cost was $2,500. Officers: Prest., L. W. Stocker. Treas., L. C. White. No other data given regarding this system.

New System: It is reported that the town has voted $30,000 for a new system, and that the bonds are now for sale. Engr., Geo. H. Leland, Providence, R. I. Chairman Water Bd., Hugh Gilchrist. No other data given. See supplement.

WINOOSKI, *Chittenden Co.* (Pop., 2,833; est., 3,500.) On Winooski river, near Burlington. Engaged in manufacturing lumber, woolen and other goods.

History.—Built in '73 by Winooski Aqueduct Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 2. *Hydrants*, Chapman, 18. *Valves*, Chapman.

Consumption, 160,160 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $35,000. Debt, none. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,000; city, $540. Hydrant rental, $30.

Management.—Prest., Jos. Sawyer. Secy. and Treas., F. C. Kennedy. Engr., G. D. Nash.

WOODSTOCK, *Windsor Co.* (Pop., 1,266; est., 1,500.) On Otta Quechee river.

History.—Built in '87 by Woodstock Aqueduct Co. Des. Engr., J. J. R. Randall, Rutland. Const. Engr., T. Wm. Harris, 45 Broadway, New York City. Contrs.: R. D. Wood & Co., Philadelphia, Pa., who furnished all material; sublet to T. Wm. Harris.

Water Supply.—Streams, by gravity.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, R. D. Wood & Co's., 20. *Valves*, R. D. Wood & Co.'s.

Consumption, not given. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Cost, $36,000. Debt, none. Other data not given, as works have only been in operation a few months.

Management.—Prest., F. K. Billings. V. Prest., F. S. Mackenzie. Secy., H. C. Phillips. Treas., F. W. Wilder. Supt., Jas. W. Hazen.

MASSACHUSETTS.

Water-Works Completed or in Process of Construction.

ABINGTON, *Plymouth Co.* (Pop., 3,697; est., 4,000.) Engaged in manufacturing boots and shoes and tacks.

History.—Built in '86 by town. The pumping machinery, stand-pipe and 6 miles of the mains are owned jointly with the adjoining town of Rockland. Des. Engr., S. C. Heald, Boston. Const. Engr., J. J. Van Volkenburg, Worcester. Contr. for masonry and foundations, G. A. Faunce; for buildings, Elijah Faunce.

Water Supply.—Big Sandy Pond in town of Pembroke, pumping to standpipe.

Pumping Machinery.—Two Worthington high-service pumping engines with dy. caps. of 2,000,000 and 1,000,000 galls., and guaranteed duty of 85,000,000 ft. lbs. per 100 lbs. of coal. Price of engines, boilers and fittings, $32,000.

Stand-Pipe.—On Beach hill in Rockland, 5 miles from, and 230 ft. above, the pond; also 129 ft. above Rockland and 135 ft. above Abington: 100 ft. high by 25 ft. in diam.; cap., 368,000 galls. Built by Cunningham Iron Works, Boston, for $12,700.

Distribution.—*Mains*, c. i., 20 miles. *Services*, cement lined iron. Pipe furnished by Warren Foundry and Machine Co., Phillipsburg, N. J., and laid by T. F. Maney & Co., Boston. *Taps*, 425. *Meters*, 30. *Hydrants*, Coffin, 120. *Valves*, Coffin.

Consumption, 150,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $155,000. Debt, not given. Int., 4 %. Ann. rev.: city, $1,400. Hydrant rental, $20. No other data given.

Management.—Three Commrs. Supt., A. H. Wright.

ADAMS, *Berkshire Co.* (Pop., 2,388: est., 9,000.) In valley of south branch of Hoosac river. Engaged in manufacturing cotton, woolen, paper and celluloid goods. Settled in 1740.

Water Supply.—Springs, at base of mountains, impounded in reservoirs, by gravity.

Reservoirs.—Two, cap., about 5,000,000 galls. each.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. *Taps*, 60. *Meters*, 14. *Hydrants*, Ludlow and Chapman, 160. *Valves*, Ludlow and Chapman.

Consumption, 800,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 110 to 140 lbs.

Financial.—Cost, $140,000. Debt, $120,000. Int., 5%. Ann. op. exp., $12,716. Ann. rev.: consumers, $12,290; city, none.

Management.—Three Commrs. Clerk and Treas., Dan'l Upton. Supt., C. A. Waters.

AGAWAM, *Hampden Co.* (Pop., 2,216.) On Connecticut river. Settled in 1660; incorp. a town in '58.

History.—Built for domestic use in '77 by C. L. Goodhue, Springfield.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, w. i. and cement, 5 miles. *Services*, galv. i. *Taps*, 74. No meters or hydrants.

Consumption, unknown. *Pressure*: 45 lbs.

Financial.—Cost, $6,000. No debt. No other data given.

Management.—Owned by C. L. Goodhue, Springfield, Mass.

AMESBURY, *Essex Co.* (Pop., 7,434: est., 9,000.) On Powow river. Engaged in manufacturing woolen goods, cotton machinery, patent flooring and carriages. In '86 a large part of the town of Salisbury was annexed to Amesbury.

History.—Built in '84 by Powow Hill Water Co. to supply Amesbury and Salisbury. Des. Engr., Chas. A. Smith. Const. Engrs., Chas. A. Smith and Walter H. Sears.

Water Supply.—Driven wells, pumping to reservoirs.

Wells.—Tubular, 36; 45 ft. deep, connected by horizontal suction pipe attached to pumps 15 ft. below surface.

Pumping Machinery.—Worthington; two 60 H. P. tubular boilers and two 1,000,000-gall. pumps, lifting 200 ft. to reservoir.

Reservoirs.—One high-pressure, cap., 2,000,000 galls.; one low-pressure, cap., 3,000,000 galls. The latter is 240 ft. above village, is constructed in earth excavation, having inner slopes puddled, and paved with boulders.

Distribution.—*Mains*, c. i., 8 miles. *Services*, at first, w. i. and cement: now, tarred w. i. Pipes and specials furnished by Gloucester Iron Works, Gloucester, N. J., and R. D. Wood & Co., Philadelphia, Pa. *Taps*, 600. *Meters*, 35. *Hydrants*, Ludlow, 115. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $90,000. Stock, $10,000. Bonded debt, $40,000. Int., 5 %. Hydrant rental, $30 for first 100, $25 for all additional. No other data given.

Management.—Prest., Richard F. Briggs. Treas., E. R. Sibley. Clerk, Geo. W. Cate.

AMHERST, *Hampshire Co.* (Pop., 4,298: est., 4,298.) On Connecticut river, has good water-power. Settled in 1721; incorp. in 1759.

History.—Built in '79 by Amherst Water Co. Des. Engr., Phineas Ball, Worcester. Const. Engrs. and Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Amethyst brook, by gravity: stream has drainage area of 3 sq. m.

Reservoir.—A storage reservoir on stream, cap., 1,000,000 galls., is formed by a masonry dam, 150 ft. long, 19 ft. high, 8 ft. wide at top and 20 ft. at bottom. Reservoir is from 150 to 330 ft. above village.

Distribution.—*Mains*, c. i. and cement, 7 miles. *Taps*, (in '86) 200. *Meters*, none. *Hydrants*, Holyoke, 25. *Valves*, Chapman.

Consumption, unknown. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $80,000. Stock, $40,000. Bonded debt, $40,000. Int., 5 %. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $1,000. Hydrant rental, $1,000 for any number.

Management.—Prest., W. A. Dickinson. Secy. and Treas., E. D. Bangs. Supt., P. E. Irish.

ARLINGTON, *Middlesex Co.* (Pop., 4,100; est., 5,000.) On broken ground at head of Mystic river, 6 miles from Boston. Engaged in vegetable gardening, drug and general manufacturing. Settled in 1735; incorp. as West Cambridge in '07; name changed to Arlington in '67.

History.—Built in '73 by town. Engrs., W. A. Mason and C. D. Elliott, Somerville, Mass. Contr., Geo. H. Norman, Newport, R. I. Extensions made by Water Commrs. with day labor.

Water Supply.—Lexington Great Meadows and North brook, by gravity from storage reservoir.

Reservoir.—Formed by dam across North brook. Has area of 31 acres, depth of 10 ft., and cap. of 77,000,000 galls.

Dam.—Earth, with puddle heart.

Filters.—The bed of the reservoir being of peat formation the water was found to have an unpleasant taste and odor, so in '76 a filter gallery was built in porous ground near reservoir; size, 135 by 12 ft., with stone walls, 4 ft. high, arched over with brick. The bottom was 12 ft. below surface of ground. From one end a semi-circular brick arch with 20-in. span, built on timber flooring, connects with 12-in. c. i. pipe leading to supply pipe from reservoir. In '77 a second filter gallery was built parallel to the first, inside the reservoir, being a brick culvert of 4-ft. span, connected at each end with first gallery by drain pipes laid with open joints. In '80 this gallery was extended 100 ft. The yield is small, the soil not being favorable for infiltration.

Brick Conduit.—Built in '77 to divert water to reservoir from the great meadows and Brown's brook; diam., 3 ft.

Distribution.—*Mains*, w. i. and cement, 13 miles. *Services*, w. i. and cement. *Taps*, 689. *Meters*, none. *Hydrants*, kind not given, 101.

Consumption, unknown. *Pressure*: Ordinary, 50 lbs, in center of town. Fire, 50 lbs., do.

Financial.—Cost, $433.636. Debt, $300,000. Int., 5 and 6 %. Ann. op. exp., $2,557. Ann. rev.: consumers, $10,645; city, $1,200. Hydrant rental, town allows $1,000 for any number.

Management.—Commrs., who serve as Supt. Report made by F. W. Hodgdon.

ASHBURNHAM, *Worcester Co.* (Pop., 1,666; est., 2,000.)

History.—Built in '70 by private company. Engr., G. C. Winchester.

Water Supply.—Springs, by gravity from impounding reservoir.

Reservoir.—Cap., 1,000,000 galls.; formed by masonry dam across ravine. Reservoir is ½ mile from, and 100 ft. above, village.

Distribution.—*Mains*, sheet iron and cement, 1 mile. *Services*, iron. *Taps*, 75. *Meters*, none. *Hydrants*, Whittier Machine Co.'s, 7.

Consumption, unknown. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $10,000. Debt, none. Ann. op. exp., $50. Ann. rev.: consumers, $325; city, none. Hydrant rental, free.

Management.—Prest., I. W. Adams. Treas., G. G. Rockland.

ATHOL, *Worcester Co.* (Pop., 4,307; est., 4,758.) On Miller's river, which affords good water-power. Engaged in manufacturing.

History.—Built in '76 by private company, under direction of S. L. Wiley.

Water Supply.—A mountain brook, by gravity from impounding reservoir.

Reservoirs.—Impounding: Area, 18 acres; 400 to 500 ft. above town. Distributing: Two, near and 200 ft. above town; area, one acre each.

Dam.—Sand, with stone masonry heart-wall; 14 ft. high and 600 ft. long.

Filter.—At impounding reservoir, of sand and charcoal.

Distribution.—*Mains*, c. i., 12 miles. *Services*, kalamein iron. *Taps*, 462. *Meters*, 12. *Hydrants*, Ludlow, 56. *Valves*, Ludlow and Chapman.

Consumption, unknown. *Pressure*: Ordinary, 140 lbs. Fire, 175 lbs.

Financial.—Cost, $140,000. Debt, $140,000. Int., 6 %. Ann. op. exp., $1,200 to $1,500. Ann. rev.: consumers, $4,674; city, $2,800. Hydrant rental, $50.

Management.—Prest., S. L. Wiley. Treas. and Supt., R. B. Boyce.

ATTLEBOROUGH, *Bristol Co.* (Pop., est., 6,000.) On Ten Mile river. Engaged in manufacturing, especially jewelry. Settled in 1696.

History.—Built in '73 by town. Engr., Geo. H. Norman, Newport, R. I.

Water Supply.—Wells and Ten Mile river, by pumping to tank, and direct pumping from river for fire purposes.

Pumping Machinery.—Worthington pump, cap. not given. Pumping is done by A. Bushee & Co., under contract with town.

Tank.—Plate iron, lined with bricks laid in cement: cap., 215,000 galls.; 60 ft. above town.

Distribution.—*Mains*, w. i. and cement, 10 miles. *Services*, w. i. and cement, galv. i. *Taps*, 755. *Meters*, 328. *Hydrants*, home-made, 110. *Valves*, Ludlow.

Consumption, 124,000 galls. *Pressure*: Ordinary, 44 lbs. Fire, 76 lbs.

Financial.—Cost, $88,742. Debt, $68,000. Int., 7 %. Ann. op. exp., $1,040. Ann. rev.: Consumers, $5,450; city, none.

Management.—Treas., M. O. Wheaton. Registrar and Supt., G. B. Fitts.

AYER, *Middlesex Co.* (Pop., 1,881; est., 2,500.) Has various manufactories.

History.—Built in '88 by town. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Collecting well, pumping to reservoir.

Pumping Machinery.—Davidson pump, dy. cap., 450,000 galls.

Reservoir.—Cap., 100,000 galls. Contr., J. R. Rook, Framingham.

Distribution.—*Mains*, c. i., 4¾ miles. *Services*, enam. i. Pipe furnished by R. D. Wood & Co., Philadelphia, Pa., and laid by C. W. Talcott, Woonsocket, R. I. *Taps*, 57. *Meters*, 2. *Hydrants*, Ludlow, 39. *Valves*, Ludlow.

Consumption, not yet known. *Pressure*: 65 lbs.

Financial.—Cost, $56,000. Debt, $56,000. Int., 4 %. No further financial data given.

Management.—Supt., H. W. Whitney. Report made by J. R. Gray.

NOTE:—As these works are just completed all the usual data could not be given.

BEVERLY, *Essex Co.* (Pop., 8,456; est., 10,000.) Engaged in commerce and manufacturing shoes and fishing tackle.

History.—Supplied from Salem, '69 '87, town owning distribution system. In '87 town completed a reservoir and pumping station for its own use. Des. Engr., Clemens Herschel. Const. Engr., Walter H. Sears.

Water Supply.—Wenham lake, direct pumping and pumping to reservoir.

Pumping Machinery.—Gaskill pump, dy. cap., 2,000,000 galls.

Reservoir.—Cap., 3,200,000 galls. Contrs., Hill, Ellingwood & Frances, Lowell.

Distribution.—*Mains*, cement-lined w. i. and steel, 50 miles. *Services*, galv. i. Pipe furnished and laid by New England Construction, Boston. *Taps*, 2,150. *Meters*, 18. *Hydrants*, Coffin, 162. *Valves*, Coffin.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Ann. rev.: Consumers, $22,350. No other data given.

Management.—Water Board: For three years, P. E. Clark; for two years, H. W. Foster; for one year, G. Swan; all elected in '88. Supt., Charles Pickett.

BOSTON, *Suffolk Co.* (Pop., 362,839.; est., 400,000. Total population supplied, est., 475,000; of this, 370,000 is supplied by the Sudbury and Cochituate, and 105,000 by the Mystic system.) On west side of Massachusetts bay at the mouth of Charles river; capital of the State and the chief city of New England. Settled in 1630 and incorp. a city in '22. The old city was on a peninsula about 2¾ miles long, 1 mile broad at its widest point, 150 ft. at its narrowest, and with an area of 783 acres. Four-fifths of the old city is on ground less than 20 ft. above tide-level, while Beacon hill has an elevation of about 100 and Copp's hill 50 ft. The area of the old city, or Boston proper, has been increased by filling in ancient coves and water-ways to 1829 acres, while the total area of the city has been increased to 36.7 sq. m. by the annexation of East Boston, South Boston, Roxbury, Dorchester, West Roxbury, Charlestown, Brighton, Breed's Island and Deer's Island.

History.—The present water supply was introduced by the city in '48, '64 and '78.

In 1652 the "Water-Works Company" was incorporated for building "the conduit," which was a reservoir about 12 ft. sq., located near the present Dock Square, to which water was conveyed by wooden pipes from neighboring springs and used for domestic and fire purposes. No further steps towards a water-supply seem to have been taken until June 10, 1796, when "The Aqueduct Corporation" was incorporated, with a capital of $130,000, to bring water into the town from Jamaica pond, in Roxbury. This company had four mains of pitch pine logs, two of 4-in. and two of 3-in. bore; the distribution pipes were also of wood with 1½-in. bore.

The first public supply of importance was introduced Oct. 25, 1848, from Lake Cochituate. This was increased in '78 by an additional supply from Sudbury river, while by the annexation of Charleston, in '74, Boston came into possession of the Mystic Water-Works which had been built in '64 and also supply Chelsea, Everett and Somerville.

For the Cochituate works the Consulting Engr. was Jno. B. Jervis and the Const. Engrs. were Wm. S. Whitwell and E. S. Chesborough. A. Fteley was Engr. in charge of const. of the Sudbury extension under Jos. P. Davis, the City Engineer of Boston. The Engr. of the Mystic works was C. L. Stevenson.

THE COCHITUATE AND SUDBURY SYSTEMS.

Lake Cochituate Supply.—By gravity from lake about 20 miles west of Boston; has a water-surface of 800 acres, a total capacity of 2,011,000,000 galls., an elevation of 134.36 ft. above "tide-marsh level" at high water mark and a drainage area of 11.87 sq. m. When drawn down 10 ft., or to the level of the flow line of the conduit, the surface area of the lake is but 489 acres. The lake is in three natural basins, respectively 72, 50 and 64 ft. deep, connected by narrow channels, in the lower of which provision is made for shutting off the water by a stop plank, thus retaining the water of the two upper basins in case repairs are needed to the dams. Pipes connect Dug pond, area 44.5 acres, elevation, 141.36 ft., and Dudley pond, area 81 acres, elevation, 146.46 ft., with the supply of the lake. Pegan brook, flowing through the village of Natick, discharged offensive matter into the lake, and in '63 a filter dam of coarse stone, with 3 ft. of pebbles in the center, was built at its mouth and has worked satisfactorily.

Dams.—At the conduit outlet of the lake are two stone masonry dams 500 ft. apart. The first dam was on quicksand, and after filling the lake springs boiled up below it, carrying sand. This necessitated the second dam, which was protected from a like fate by a line of 8-in. tongued and grooved sheet piling driven 15 to 20 ft. in the gravel.

Cochituate Conduit.—From Lake Cochituate to Chestnut hill reservoir, 14½ miles long. Oviform, with large end down, 6.33 ft. high and 5 ft. wide. Of brick, 8 in. thick, plastered outside from top to spring of invert. It rests on earth throughout, the foundation on embankments being puddled. It is generally in excavations, has cuts of over 30 ft. and two tunnels. The gradient is between 3 and 4 in. a mile except at the crossing of Charles river, which is by inverted siphons of cast iron pipes, two of 30-in. and one each of 36 and 40 in. pipes, for 1,095 ft. with a fall of 0.51 ft. between the ends. Approaching the river the conduit is carried on a 30-ft. granite bridge, then for some distance on a puddled embankment 40 ft. high to the river; the siphon pipes cross the river on a granite bridge, the pipes being 71 ft. above the river and 52 ft. lower than the ordinary grade line of the conduit.

Brookline Reservoir.—At the termination of the old conduit; has an area of 22.95 acres, a depth of from 12 to 24 ft., a capacity of 120,000,000 galls. and when full is 124.6 ft. above tide-level.

Chestnut Hill Reservoir.—Built from '65 to '70. About 1 mile from the Brookline reservoir, with which it is connected by a conduit. Cap., about 700,000 galls.; elevation, 124 ft. above tide-level. It is irregular in shape and is divided by a water-tight dam having a gate chamber so arranged that either basin can be emptied.

Pumping Machinery.—H. R. Worthington and Whittier Machine Co.'s pumping engines.

Parker's Hill High Service Reservoir.—About three miles from Boston and 219 ft. above tide-level: cap., 7,200,000 galls.; filled by pumping from a station in Roxbury district, the lift being 108.5 ft.

South Boston, East Boston and Deer Island have each been supplied by laying mains across rivers.

Sudbury River Supply.—Brought from Sudbury river to Farm pond, in Framingham, and thence to the Chestnut hill reservoir, described above. The river has a drainage area of 78.24 sq. m. and a daily flow of 750,000 galls.

Storage Reservoirs.—Three dams at the confluence of two streams formed as many reservoirs, the water from any one of which can be drawn immediately to the conduit leading to Farm pond. The dams are of earth with heart walls and overflows of stone masonry. The three reservoirs, or basins, have a storage capacity of nearly 2,000,000,000 galls., while a fourth basin has been constructed recently.

Sudbury Conduit.—To Farm pond, a natural lake of 200 acres, 4.170 ft., and from thence to Chestnut hill reservoir, about 16 miles, with a grade of 1,056 ft. per mile. The conduit is of brick, oviform, has a sectional area of 56.75 sq. ft., with concrete foundation, and side walls and spandrel backing of rubble-stone masonry. When above natural surface the conduit rests upon embankments of selected earth. The Charles river is crossed on a granite bridge 475 ft. long and 75 ft. high, and the Waban Valley by a granite bridge 536 ft. long and 40 ft. high. On the bridges the inside of the conduit is lined with cement, and spaces for drainage are left in the side walls of the bridges.

Arrangements for measuring flow of water are made at certain points along the conduit and since its completion the most accurate measurements ever made of the flow of water in large masonry conduits have been conducted by A. Fteley, the engineer in immediate charge of the construction of these works. (See references below.)

Sudbury and Cochituate Distribution.—*Mains*, c. i., 436.5 miles. *Services*, lead. *Taps*, 55,235. *Meters*, 3,114; of which 1,423 are Crown, 859 Worthington, 486 Tremont, 301 "B. W. W.," and the remainder Ball & Fitts, Desper, Balance Valve, Hersey, Star, Frost, Spooner and Thompson. *Hydrants*, Post and Lowry, 4,990. *Stop-gates*, 4,667.

Consumption, 29,852,100 galls. *Pressure*: Ordinary, 35 to 75 lbs. Fire, 35 to 75 lbs.

Financial.—Cost, $19,527,483. Debt, $13,217,474. Int., 3½ and 6 %. Sinking fund, $4,271,168. Ann. op. exp., $341,693. Ann. rev.: consumers, $1,163,737; city, $111,561.

THE MYSTIC SYSTEM.

Mystic Lake Supply.—Water is conveyed by gravity to pumping station and thence is pumped to Walnut Hill reservoir. Lake is 6¼ miles from Charleston, in the "towns" of Medford, Arlington and Winchester: has a storage capacity of 380,000,000 galls., an area of about 200 acres, a drainage area of 27¾ sq. m., and a surface elevation of only 7 ft. above tide-level.

Dam.—Was built across a narrow portion of the lake, 1,560 ft. long and carried 11 ft. above high water mark; was of earth on piling and puddle, lined on each slope with puddle and rip-rap and having an overfall of granite masonry, and a large plank fish-way.

Mystic Conduit.—To pumping station from gate-house at dam: the conduit extends along north branch of Mystic river for 7,463 to a pipe-chamber from which it crosses the river to the pump-well. The conduit to the river is of brick, oviform, 5.67 ft. high and 5 ft. wide, the base being a 5-ft. semicircle. The river is crossed by iron pipes.

Pumping Machinery.—Two 5,000,000 gall. and one 8,000,000-gall. Worthington pumping engines.

Walnut Hill Reservoir.—Serves as receiving and distributing reservoir and is situated so that it can supply any of the towns between the Charles and northern slope of the Mystic river. At present it supplies the Charleston district and the towns of Chelsea, Everett and Somerville. It has a high water elevation of 147 ft. above tide-level, an area of 4½ acres, depth of 26 ft. and a capacity of 26,244,000 galls. Its inner slopes are 1½ to 1 and are lined with 2 ft. of puddle covered with 8 in. of brick work. The bottom is puddle and covered with 3 in. of concrete.

Fisher Hill High Service Reservoir.—Completed Nov., '87, and filled to high water-mark, Jan. 1, '88; is 295 by 500 ft. at the water-line, and 218 by 423 ft. at the bottom of the slope; has a capacity of 15,000,000 galls. and is 241 ft above tide-level.

Mystic Distribution.—*Mains*, c. i., w. i. and cement, 137.76 miles. *Services*, lead. *Taps*, 16,801. *Meters*, 420; of which 201 are Worthington, 191 Crown, and the others, Tremont, Ball & Fitts, "B. W. W.", and Star. *Hydrants*, Lowry, 935. *Stop-gates*, 1,301.

Consumption, 7,629,000 galls. *Pressure*: 50 lbs.

Financial.—Cost, $1,659,639. Debt, $839,000. Int., 3½ and 6 %. Ann. op. exp., $153,345. Ann. rev.: consumers, $292,449, of which $83,904 was refunded to Chelsea, Everett and Somerville, leaving a net revenue for Boston of $208,645; city, $15,489.

Management.—*Whole System*:-Water Board, Registrar, Wm. F. Davis. Supt. Meter Dept, Wm, J. Welsh, Supts.: Desmond Fitzgerald, of Western Division of Cochituate and Sudbury Systems; Dexter Brackett of Eastern Division of Cochituate and Sudbury Systems and also of Mystic System.

References.—The papers and articles mentioned below contain valuable, interesting and detailed information regarding the Boston Water-Works.

"The Flow of the Sudbury River, Massachusetts, for the years 1875-9". With numerous diagrams, illustrations and tables. By Alphonse Fteley. A valuble paper for all interested in the flow of rivers and its relation to water supply. Trans. Am Soc. C. E., vol. X., pp. 225-34.

"Descriptions of some Experiments on the Flow of water made during the Construction of Works for Conveying the water of Sudbury River to Boston. With 30 tables and 11 plates. By Alphonse Fteley and F. P. Stearns, An exhaustive paper, fully illustrated. Trans. Am. Soc. C. E., vol. XII., pp., 1-118.

"Evaporation". A description of experiments made by Desmond Fitzgerald in connection with the Boston Water-Works. With many tables, diagrams and illustrations showing both the results and methods of the experiments. Trans. Am. Soc. C. E., vol. XV., pp 581-642.

"Analysis of the Rainfall of Lake Cochituate, Mass., 1852-83". With tables and diagrams. Refers to amount of rainfall. By Desmond Fitzgerald. Trans. Am. Soc. C. E., Vol. XIII., pp. 359-75.

"The Gauging of Streams". With tables and diagrams illustrating the number of cubic feet of water discharged per second per square mile of drainage area in the Croton, Sudbury, Concord, Merrimac and Connecticut rivers. Largely statistical. By Clemens Herschel. Trans. Am. Soc. C. E., vol., VII., pp. 236-42.

The following references are to volumes and pages of *Engineering News*:

History of Boston Water Supply. V., pp. 4, 12, 21, 28, 37, 52, 61, 78, 95, 102, 111, 113, 115, 117, 125, 134, 154, 160 and 167.

Charles River Bridge. A paper read by A. Fteley before the Boston Society of Civil Engineers describing the bridge over the Charles River for carrying the Sudbury Conduit of the Boston Water-Works. VII., p. 220.

"The Deacon Meter and Waste of Water in Boston". VII., p, 224.

"History and Statistics of the Boston Water Works". VIII., pp. 131-141.

"Fisher Hill Reservoir". XIV., pp. 233 and XIX , pp. 226.

"Raising a 40-in, Main". XV., pp. 55.

"Boston Water Supply", in papers on "Municipal Engineering", gives a detailed account of the distribution system, weights and dimension of pipes and description of hydrants and stop-gates. Illustrated, XV., pp. 83-4, 113-14.

BRAINTREE, *Norfolk Co.* (Pop., 3,855: est., 4,500.) In agricultural and manufacturing district, 10 miles from Boston.

History.—Built in '87 by Braintree Water Supply Co. Engr., Wm. Wheeler, Boston. Contr., Wheeler and Parks, Boston. Town has voted to buy the works.

Water Supply.—Little pond, pumping to stand-pipe.

Filter Gallery.—Stone walls, brick arch, 100 by 15 ft., by 16 ft. deep.

Pumping Machinery.—Blake pump, dy. cap., 1,000,000 galls.

Buildings.—Brick pump house. Contrs.: brick-work, F. O. Whitmarsh; wood-work, M. L Tupper.

Stand-Pipe.—Made by E. Kendall, Cambridgeport: 100 ft. high by 30 ft diam

Distribution.—*Mains*, c. i., 12 miles. *Services*, enam., i. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., trenching and pipe laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 200. *Meters*, 25. *Hydrants*, Coffin 100 *Valves*, Coffin.

Financial.—Cost, $175,000. Stocks, $100,000. Bonds, $100,000. Int., 5%. Hydrant rental, free. No other data given.

Management.—Prest., F. A. Hobart. Treas., J. M. Chapman. Supt., S. A. F. Mansfield.

BRIDGEWATER AND EAST BRIDGEWATER, *Plymouth Co.* (Pop.: Bridgewater, 3,620; est., 4,000. East Bridgewater, 2,710; est., 3,000.) Engaged in manufacturing iron, brass and cotton goods.

History.—Built in '87 by National Water-Works Syndicate, Boston. Engr., Geo. Alexander, Boston.

Water Supply.—Source not given. The original plan comprised a 2,000,000-gall. Washington pump, and a stand-pipe on a hill between the two towns.

Distribution.—*Mains*, 20 miles.

Financial.—Capital Stock, $100,000. Bonds, $100,000, Int., 5%.

Management.—Genl. Mgr. B. C. Mudge, 70 Kilby St., Boston. Supt., H. K. Jackson. Asst. Supt., H. H. Thorndike.

BROCKTON, *Plymouth Co.* (Pop., 13,608; est., 23,000.) Manufactures boots and shoes. Settled in 1700; incorp. a city in '81.

History.—Built in '70 by town, for fire protection, having No. 7 Knowles pump, a reservoir, ⅛ mile of pipe and 7 hydrants. This system was extended in '77 by adding 2½ miles of pipe. In '80-1 the town built works for general supply. Engr. Phineas Ball, Worcester.

Water Supply.—Salisbury brook, by gravity from impounding reservoir.

Dam.—Reservoir is formed by earth dam, 25 ft high, 1,500 ft. long, with heart, wall of rubble and cement, and with upper portion of water-face paved with stone.

Reservoir.—Cap., 330,000,000 galls.; three miles from, and from 18 to 122 ft above city. A portion of bottom of reservoir was prepared for filtering by laying 4-in drain tiles 30 ins. below surface and 8 ft. apart. This area covers 55,000 sq. ft. A chamber 750 ft. from the dam contains conduit 3½ ft. wide and 4 ft. high, having side walls and arch built of rubble, stone and concrete. It was intended to convey water from the filter through this conduit to the supply pipe, but up to '83 this had not been done.

Distribution.—*Mains*, c. i., w. i. and cement, 32½ miles. *Services*, w. i. and cement. *Taps*, 2,100. *Meters*, 1,200. *Hydrants*, Ludlow, 295. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: *Ordinary*, 45 lbs. Fire 45 lbs.

Financial.—Cost, $130,000. Debt, $332,000. Int., 4½ %. Ann. op. exp., $3,000. Ann. rev.: Consumers, $25,000; city, $3,000. Hydrant rental not given.

Management.—Commrs.: E. H. Reynolds, W. T. Cleaveland, F. B. Gardner.

BROOKFIELD, *Worcester Co.* (Pop. 2,820; est., 3,000.) In farming country and has large boot factories and cotton mills.

History.—Built in '88 by town. Engr., A. C. Moore. Contrs., Mc Bride & Hennessey, Boston.

Water Supply.—Springs, by gravity. There is a reservoir with an area of ¾ acres.

Distribution.—*Mains*, iron, 1.8 miles. *Hydrants*, 10.

Financial.—Cost, $16,000. Debt, $16,000. Int., 4½ %.

The works were not fully completed at time of report, which was made by C. B. Carpenter.

BROOKLINE, *Norfolk Co.* (Pop., 8,057; est., 10,500.) On Charles river and a small tidal estuary called Muddy river and is opposite Boston. It comprises 200 acres of salt marsh, 500 acres of a plain of river gravel rising to about 100 ft. above tide and hills of glacial drift rising from 300 ft. to 500 ft. above tide. Settled in 1634 and incorp. in 1705.

History.—Built in '75 by town. Engr., Edw. S Philbrick.

Water Supply.—Ground water, pumping to reservoir and tank. Water is taken from a collecting and filter gallery, 6 miles from center of town on Cow island, a ridge of gravel surrounded by marshes, along side the Charles river.

Filter Gallery.—From 100 to 300 ft. from river in clean, coarse sand and gravel with bottom 6 ft. below lowest stage of river. It is 4 ft. wide, with vertical side walls 2 ft. high of uncemented rubble stone, and covered by an 8 in., semicircular brick arch. Owing to a peat bog from which it was not desirable to take water the gallery is in two sections, one 451 ft., and one 271 ft., long. These were originally connected by 389 ft. of 24-in. stone-ware pipe with cemented joints. In '78 an addition was made to one of the galleries, 160½ ft. long, 6 ft. wide, and 6 ft. high in the center. Weirs are so arranged that water can be drawn to the filters directly from the reservoir. The latter work was done after plans made by Shedd & Sawyer, of Boston, who found that 430 ft. of the longer gallery had been rendered useless by the fall o

18 ft. of the arch so that the gallery was full of debris. In '75, when the galleries were first constructed, the yield was 1,600,000 a day. In '80, with the new gallery, the yield was only 1,000,000 galls. a day, while the daily consumption was 1,200,000 galls. The yield was increased to 1,300,000 galls. by following the recommendation of Gen. Geo. D. Greene to cut a canal parallel to and connected with the river. This canal was from 30 to 50 ft. from the gallery, 150 ft. long below the river level.

Old Conduit.—The pumping station was originally 3,074 ft from the filter galleries and connection was made by a 25-in. stone-ware pipe laid on a timber foundation in saturated gravel and sand 6½ to 10 ft. below the surface of the swamp. It was soon found that 10 per cent. of the pipes had broken under the weight of the superincumbent gravel. This conduit was then removed and replaced by a flume of 3-in. white pine plank, 2 ft. sq., inside, with tongued and grooved joints. In about three years complaints were made regarding the impurity of the water and on examining the flume it was found that the wood had shrunk and was admitting swamp water and sand through the joints. The pumping station was moved near to the filter galleries and connected with them by the new gallery mentioned above thus doing away with the old conduit.

Pumping Machinery.—Low service, Worthington pump, dy. cap., 2,000,000 galls.; high service, Blake pump, dy. cap., 1,500,000 galls.

Reservoir.—Cap., 6,050,000 galls. On Fisher's hill for low-service supply: excavation and embankment, with the bottom first covered with 12-in. and the slopes with 18 in. of clay puddle, after which the bottom was covered with a 4-in. layer of gravel concrete and the slopes with 12-in. of broken stone against which was laid a 15-in. dry slope wall of stone. During construction springs in the gravel banks gave trouble by softening the puddle. This was obviated by making pockets of broken stone and leading the spring water through the puddle by gas pipes; these pipes were plugged after the work was completed.

Tank.—Cap., 450,000 galls.; iron, painted inside, and roofed over.

Distribution.—*Mains*, c. i, 35.4 miles. *Services*, w. i. and cement, enam. i., lead. *Taps*, 1,501. *Meters*, 156 *Hydrants*, Carr, 204. *Valves*, Chapman, Whittier Machine Co.'s.

Consumption, 767,000 galls. *Pressure*: Ordinary, 75 lbs. Fire 75 lbs.

Financial.—Cost, $768,322. Debt, (in '86) $591,000. Int., 4½ and 7%. Ann. op. exp. $13,332. Ann. rev.: consumers, $13,255; city, $10,593. Hydrant rental, $24.50.

Management.—Water Board of three, Chairman, Wm. K. Melcher. Clerk and Registrar, Francis Hunnewell. Supt., F. F. Forbes. Engrs.; low service, Richard J. Flinn; high service, Wm. B. Webber.

NOTE: A special Committee on extension of the Water-Works was appointed in town meeting, July 26, '87, and printed report of investigations, with plans for, improvements, has since been published. This report recommends "that immediate steps be taken for an increased water supply, and to that end, the act of the legislature be accepted and the right acted upon by the town as soon as practicable" The report also advises that some measures be taken "to reduce the present water consumption of the town, either by meters or otherwise," and recommends consideration of plans for covered reservoir or some other means of preserving the purity of the water, the supply from the Fisher hill reservoir being considered unsuitable for domestic purposes.

CAMBRIDGE, *Middlesex Co.* (Pop., 52,699; est., 65,000.) Separated from Boston by Charles river. Founded in 1630.

History.—Built in '55 by a corporation known as the Cambridge Water-Works when population was about 20,000. Consult. Engr., Jno. H. Blake, Jersey City, N.J. Contr., Gardner Warren. Works were purchased by city in '76. Previous to this a few families had been supplied by the Cambridgeport Aqueduct Co., chartered in '37, who laid logs with 3 in. bore to convey water from springs in Somerville to a reservoir in the eastern part of Cambridge, known as Lowerport. This reservoir was 40.5 by 20.5 ft., depth unknown, and was 27 ft. below the springs.

Water Supply.—Fresh pond in Cambridge and Stony brook in Waltham, by pumping to reservoir and stand-pipe. In '76 an additional supply was obtained by laying a conduit of wood and brick, with sectional area of 10.65 sq. ft. and length of 4,061 ft., to Spy pond, Little pond and Wellington brook. This extension is said to have cost $80,000, but owing to the pollution of the water from Spy pond and Wellington brook this supply could be used but a little while each year, and has been abandoned. In '80 a pipe was laid across Charles river to connect with the Mystic division of the Boston water-works, but it was found that no water could be spared and the pipe has never been used. The Stony brook system was completed in '87.

The drainage area of Fresh pond is 12,000 acres, and at high water the pond has an area of 190 acres. The pond is capable of supplying 1,500,000 galls. per day in dry weather. The source of Stony brook is Sand pond,and the basin is connected with Fresh pond by 7 miles of pipe. The dam on Stony brook is near the Waltham line, and the pond formed by it has an area of about 75 acres and a capacity of 360,000,000 galls. The improvements at Stony brook are said to have cost $170,000.

Dam.—At Stony brook: earth, with masonry core; length, 1,100 ft., height, 85 ft.

Reservoir.—Cap., 5,375,321 galls. The original size has been increased, the dimensions now being 340 by 170 ft., by 15.13 ft. deep. The bottom and sides are of clay puddling, 20 in. thick, covered with 4 in. of concrete. The inner sides slope 1.3 to 1 and are paved with cement laid granite blocks, 8 in. thick. The coping is 3 ft. high by 2 ft. wide. The reservoir is divided in two parts by a partition wall 3 ft. lower than the coping, there really being two reservoirs constructed at different dates, and each having separate supply pipes. Outside of the coping is an embankment and retaining wall. The former is 7 ft. wide on top, having 3 ft. of walk and 4 ft. of sodding. The sodded slope of the embankment is 1.25 to 1 and extends to the retaining wall, which is 8.37 ft. below the reservoir coping, has an average width of 7 ft. and a height ranging from 6 5 to 23 ft. The distance from the outside of the reservoir coping to the outside of the retaining wall coping is uniformly 23 ft. The top of the reservoir coping is 86.35 ft. above mean low tide and 35.19 ft. above high water in Fresh pond.

Stand Pipe.—Made by Campbell Bros. It is of riveted boiler iron, 5.42 ft. in diam., has an overflow 130 ft. above mean tide level and 79 ft. above high water in Fresh pond. The stand-pipe proper rests on a granite foundation and is protected by a circular building of granite, brick and wood, 13 ft. in outside diameter at bottom and 10 ft. at top, having a spiral staircase inside and a landing on top.

Pumping Machinery.— Worthington pumps; two, with dy. cap. of 720,000 galls. each,erected in '55; one,of 5,000,000 galls. erected in '68, and a similar one in '74. The present combined dy. cap. of the pumps is given as 6,000,000 galls.

Buildings.—Engine house and boiler room of brick.

Distribution.—*Mains*, c. i., w. i. and cement, 100 miles. *Services*, galv. i. *Taps*, 9,000. *Meters*, 219. *Hydrants* 613,made by Chapman Valve Co., Whittier Machine Co., and Coffin Valve Co. *Valves*, do.

Consumption, 3,861,400 galls. *Pressure*: Ordinary, 28 lbs. Fire, 48 lbs.

Financial.—Cost, $2,436,496. Debt, $1,825,500. Int., 3½ to 6 %. Total ann. expenditure, $186,000. Total ann. rev., $206,000. Hydrant rental, $30 to $40.

Management.—Supt., Hiran Nevons.

NOTE:—For more detailed account see *Eng. News*, vol. V., p. 146; vol. VIII., p. 264.

CANTON, *Norfolk Co.* (Pop., 4,516; est., 5,000.) In farming country 15 miles from Boston. Manufactures shovels, stove-polish, copper, cotton and woolen goods.

History.—Work begun in May and to be finished in Oct., '88; being built by town. Engr., Wm. Wheeler.

Water Supply.—Springdale and Henry's springs, by pumping to stand-pipe.

Distribution.—*Mains*, 13¾ miles. *Hydrants*, 110. *Pressure*: 48 to 98 lbs.

Financial.—Cost, from $125,000 to $150,000. Authorized bonds, $150,000, running from 1 to 30 years. Int., 4 %.

Management.—Chairman Water Board, F. M. Ames.

Works were not completed at time of report.

CHELSEA, *Suffolk Co.* (Pop., 21,782; est., 31,000.) A suburb of Boston. Has large manufactories.

History.—Supplied in '67 from Mystic Water-Works, then owned by Charleston, but now owned by Boston. The distribution system is owned by Chelsea. All data included under Boston.

CHESHIRE, *Berkshire Co.* (Pop., 1,537; est., 1,500.) At head of one of the main branches of the Hoosac river, in valley between high mountains. Settled in '67; never incorp.

History.—Built in '75 by Cheshire Water Co. Engr., Jno. J. Marsh, North Adams.

Water Supply.—Brooks fed by mountain springs, by gravity from impounding reservoir.

Reservoir.—Area, ¾ acres: 200 to 280 ft. above village.

Dam.—Stone masonry. 40 ft. long and 12 ft. high. built across rocky gorge. Contr., Hascal Dodge, Pittsfield.

Filter.—Water is drawn from the pond, or reservoir, through a 6 by 12 ft. chamber in the dam containing gravel and charcoal placed between wire screens.

Distribution.—*Mains*, c. i., 4 miles. Furnished by R. D. Wood & Co., Philadelphia, Pa., laid 4 ft. deep and covered with 1 ft. of charcoal braize to prevent freezing. *Services*, galv. i. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 125.

Consumption, unknown. *Pressure*: Ordinary, 125 lbs. Fire, 125 lbs.

Financial.—Cost, $17,000. Stock, $15,000. Debt, not given. Ann. op. exp., $100. Ann. rev.: consumers, $900; city, none. Hydrant rental, free.

Management.—R. A. Burget, H. A. Northup and Supt., J. B. Farnam.

CHICOPEE, *Hampden Co.* (Pop., est., 6,800.) On Chicopee river at its junction with Connecticut river, three miles from Springfield. Settled in 1636; incorp. in '84.

History.—In '45 a water supply was obtained from springs after plans prepared by Stockwell Bettes, of Springfield. In '77 the present works were built, and in '86 they were extended. The works are owned by Chicopee Water Co.

Water Supply.—Brook fed by springs, by gravity and pumping to tank from impounding reservoir.

Reservoir.—Cap., 5,250,000 galls.; covers 3½ acres and has average depth of 6 ft. Surface of water is from 20 to 80 feet above town.

Dam.—Is 150 ft. long, 12 ft. high and 8 ft. wide on top, with earth slopes 2½ to 1 on water, and 1½ to 1 on outer side. In centre is a brick and cement wall resting on bed of quick-sand confined by two rows of 6-in sheet piling driven 12 ft. below base of dam. Contr., W. C. McClallan, Boston.

Pumping Machinery.—Deane pump, cap., 200,000 galls. in 10 hours. Boiler, upright, made by R. F. Hawkins, Springfield.

Stand Pipe.—Made by R. F. Hawkins, Springfield, 40 by 30 ft.

Distribution.—*Mains*, c. i., w. i. and cement, 12 miles. *Services*, lead and w. i. Pipe furnished by National Tube Works Co., McKeesport, Pa. *Taps*, 820. *Meters*, 3. *Hydrants*, Chapman, 35. *Valves*, Chapman.

Consumption, 30,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost $80,000. Stock, $75,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $7,800; city $1,600. Hydrant rental, about $1,600 for fire service.

Management.—Prest. W. C. McClallan. Treas., Emerson Gaylord, Secy. and Supt., E. R. Stickney.

CHICOPEE FALLS, *Hampden Co.* (Pop., 4,000; est., 5,000.) On Chicopee river. Settled in 1640, and was part of Springfield until '48.

History.—Built in '81-3, jointly by village and Chicopee Manufacturing Co., the former owning the distribution system and the latter the pumping machinery and reservoir.

Water Supply.—Chicopee river, by pumping to reservoir.

Pumping Machinery.—In the mills of above company and driven by their power; dy. cap., not known.

Reservoir.—Owned by company; no other data given.

Distribution.—*Mains*, c. i., 0.4 miles. *Services*, w. i. *Taps*, 3,000. *Meters*, 2. *Hydrants*, kind not given, 45.

Consumption, unknown. *Pressure*: Ordinary, 70 lbs. Fire, 150 lbs.

Financial.—Cost, $20,000. Debt., $12,000. Int., 4½%. Ann. op. exp., $800. Ann. rev.: consumers, $2,301; city, $365. The company has one-half the revenue from consumers, and is paid $365 for hydrant rental.

Management.—Prudential Comm. Treas., H. J. Boyd.

CLINTON, *Worcester Co.* (Pop., 8,029; est., 10,000.) On Nashua river. Engaged in manufacturing. Incorp. a village in '50.

History.—Built in '82 by town. Des. Engr., M. M. Tidd, Boston. Const. Engr., Jno. T. Langford. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Springs and surface water, by gravity from storage and impounding reservoirs. Drainage area, about 700 acres.

Reservoirs.—Two storage reservoirs formed by earth dams with paved slopes receive drainage from about 200 acres. Water from these reservoirs passes through a valley receiving drainage from about 500 acres to an impounding reservoir, whence it is conveyed 6 miles through 16-in cast-iron pipe to distributing reservoir on Burdett hill, in city, 28 ft. below storage reservoir and 200 feet above river. This reservoir has earth banks with heart walls of masonry and a concrete bottom. It is 168 feet sq. and 15 ft. deep; cap., 25,000 galls The combined storage cap. of the reservoirs is 20,000,000 galls., the dy. cap. is 6,000,000 galls.

Distribution.—*Mains*, c. i., 21 miles. *Services*, w. i. and cement. *Taps*, 950. *Meters*, 40. *Hydrants*, Chapman, 135. *Valves*, Chapman.

Consumption, 400,000 galls. *Pressure*: Ordinary, 80. Fire, 100 lbs.

Financial.—Cost, $250,000. Debt, $248,000. Int., 4%. Ann. op. exp., $3,000. Ann. rev.: consumers, $14,000; city $3,000. Hydrant rental, not given.

Management.—Three Commrs. Supt., H. H. Lowe. Report made by J. F. Philbin.

COCHITUATE, *Middlesex Co.* (Pop., 1,161; est., 1,200.) In town of Wayland. Incorp. in '35.

History.—Built in '78 by town. Des. Eng., Hiram W. Blaisdell, Concord.

Water Supply.—Snake brook, by gravity from impounding reservoir, with direct pumping for fire protection. Brook has drainage area of ⅝ sq. m.

Reservoir.—Area, 13 acres; cap., 16,000,000 galls.; 68 ft. above village.

Dam.—Earth 130 feet long by 30 feet high, with heart-wall of rubble masonry 3 ft. thick at bottom and 22 ins. at top.

Filter Gallery.—A trench 400 feet long was dug near bank of reservoir from 10 to 6 ft. below high water, and with two 80 ft. branches extending beneath reservoir. A dry stone culvert, 18 in. high by 12 ins. wide, was built in trench, and covered with earth. Gallery terminates in a 6 ft. well 200 ft. above dam; 227 ft. of 10 in. cast-iron pipe leads to a chamber below dam connecting with the supply main. There has been some trouble with the water from the filter galley on account of a vegetable growth making an ochreous deposit in the pipes.

Pumping Machinery.—Amoskeag rotary pump driven by a 30-in. turbine wheel of 40 H. P. An 18 in. pipe leads through the dam to the pump, and in case of fire the supply is drawn through this directly from the pond and the pressure increased for fire purposes.

Distribution.—*Mains*, c. i., 5.5 miles. *Services*, w. i. *Taps*, 180. *Meters*, none. *Hydrants*, Mathews, 32. *Valves*, Chapman.

Consumption, unknown. *Pressure*: Ordinary, 30 lbs. Fire, 88 lbs.

Financial.—Cost, $29,000. Debt, $29,000. Int. 4 and 5%. Ann. op. exp., $100. Ann. rev.: consumers, $2.700, city, $384. Hydrant rental, $12.

Management.—Commrs.: A. H. Bryant, C. H. Boodey and W. H. Burt. Supt., R. Burt.

COHASSET, *Norfolk Co.* (Pop. 2,182, est., 2,300.) On south shore of Massachusetts bay, 21 miles from Boston. Favorite summer resort.

History.—Built in '86 by Cohasset Water Co. Engr., M. M. Tidd, Boston. Contrs. Wm. McClallan, Boston, and Calvin Horton & Son, Somerville.

Water Supply.—From 65 2-in. driven wells, pumping to stand-pipe.

Pumping Machinery.—Blake compound duplex pump; dy. cap., 750,000 galls.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, cement-lined iron. Pipe furnished by Gloucester iron Works, office, 6 North Seventh street, Philadelphia, Pa., and laid by W. C. McClallan, Boston. *Taps*, 150. *Meters*, none. *Hydrants*, Chapman, 30. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, not given.

Financial.—All data withheld.

Management.—Prest. C. A. Welsh. Treas., Jas. H. Bowe, Registrar, C. Lathrop. Supt., D. N. Tower.

CONCORD, *Middlesex Co.* (Pop. 3,922; est., 3,900.) On Concord river. Portion of village supplied with water is generally level, but part of the village is on undulating ground. Settled in 1635.

History.—Built in '74 by town. Engr., Wm. Wheeler, Concord. Contrs., Ferris & Halladay, Jersey City, N. J.

Water Supply.—Sandy pond, by gravity.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, w. i. and cement, 26 miles. *Services*, enam. i. Pipe furnished by contractors. *Taps*, 620. *Meters*, 6. *Hydrants*, Whittier Machine Co.'s, 105. *Valves*, Whittier Machine Co.'s.

Consumption, 500,000 galls. *Pressure*: Ordinary, 44 lbs. Fire, 44 lbs.

Financial.—Cost, $132,000. Debt, (in '86) $130,000. Int., 4%. Ann. op. exp., $800. Ann. rev.: consumers, $14,500; city, $1,500. Hydrant rental, $15.

Management.—Commrs.: Samuel Hoar; E.C.Damon and A. J. Hosmer. Supt., Jno. O, Haskell.

COTTAGE CITY, *Dukes Co.* (Pop., 672; est., winter, 1,000, and in summer runs above 10,000.) On Martha's Vineyard, an island off the Atlantic Coast. A summer resort.

History.—A fire protection system built in '84 by the fire district under the direction of Moses Jay, Jr.

Water Supply.—Lake Anthony, by direct pumping. The lake has an area of 10 acres, is supplied by springs, and has a dam to keep out the tide.

Pumping Machinery.—Knowles pump; dy. cap., 500,000 galls.

Distribution.—*Mains*, c. i., 0.5 miles. *Hydrants*, Holyoke, 9. *Pressure*: 180 lbs.

Financial.—Cost, $10,000. Ann. op. exp., $500.

Management.—Address H. J. Green.

NOTE:—The Legislature has granted the town the right to construct a new system, but no action has yet been taken.

DALTON, *Berkshire Co.* (Pop., 2,052; est., 2,300.)

History.—Built in '84 by fire district of town. Works designed and constructed by the Water Commissioners.

Water Supply.—Mountain brook, by gravity from reservoir.

Reservoir.—Cap., 3,250,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 336. *Meters*, none. *Hydrants*, kind not given, 37.

Consumption, 27,000 galls. *Pressure*: Ordinary, 141 lbs. Fire, 141 lbs.

Financial.—Cost, $59,000. Debt, $50,000. Int., 4%. Ann. op. exp., $400. Ann. rev.: consumers., $3,054; city, none. Hydrant rental, free.

Management.—Commrs.: C. Gleanon, W. M. Crane and A. E. Chamberlain. Treas., Jno. D. Carson. Clerk, W. B. Clark. Supt. A. E. Chamberlain.

DANVERS, *Essex Co.* (Pop., 6,598; est., 8,000.) On Porter's river, an arm of sea, on rolling ground rising from sea to a height of 250 ft. Engaged in manufacturing shoes, leather and brick; also in gardening and farming.

History.—Built in '76 by town. Des. Engr., Geo. H. Bishop. Const. Engr. and Contr., Geo. H. Norman, Newport, R. I. This system supplies the village of Tapleyville, in the town of Danvers, and Middleton, which is on the pipe line.

Water Supply.—Middleton pond, pumping to reservoir. Pond is 5 miles from town, has area of 106 acres, drainage area of 3 sq. m, and is about 30 ft. above sea-level.

Pumping Machinery.—Worthington pump, dy. cap., 2,000,000 galls.

Reservoir.—Cap., 5,500,000 galls.; on Hawthorne hill, 230 ft, above sea-level, in excavation and embankment.

Distribution.—*Mains*, w. i. and cement, 37 miles. *Services*. w. i. *Taps*, 1,212. *Meters*, 25. *Hydrants*, Ludlow. 205.

Consumption, 450,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $253,825. Debt, $239,160. Int., 4 and 5 %. Ann. op. exp., $5,574. Ann. rev.: consumers, $14,941; city, $4,400. Hydrant rental, $20.

Management.—Water Board. Registrar, Henry Newhall. Supt. of Pipes, H. J. Harrigan.

DEDHAM, *Norfolk Co.* (Pop., 6,233; est., 6,700.) On Charles river. Engaged in manufacturing woolen goods, loom pickers, brooms, absorbent cotton, suspenders, cocoa, chocolate and gold-leaf. Settled in 1635; incorp. a village in 1636.

History.—Built in '81 by Dedham Water Co. Engr., Percy M. Blake, Hyde Park. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Surface water, pumping to stand-pipe from well.

Well.—Is 26 ft. in diam. and 18 ft. deep, lined with heavy stone-work, laid dry, and faced on the inside from 3 ft. above the bottom to 1 ft. below the top with 12 ins. of brick and cement. Well is roofed and ventilated.

Pump-Well.—Brick, 8 ft. in diam. and 18 ft. deep, connected with supply well by 16-in. c. i. pipe.

Pumping Machinery.—Knowles pump, dy. cap., 1,000,000 galls. Two 60 H. P. return tubular boilers.

Stand-Pipe.—Made by Kendall & Roberts, Cambridgeport; plate iron, 20 ft. in diam. and 103 ft. high.

Distribution.—*Mains*, w. i. and cement, 17 miles. *Services*, enam. i. *Taps*, 650. *Meters*, 3. *Hydrants*, Ludlow, 100. *Valves*, Ludlow and Chapman.

Consumption, 154,982 galls. *Pressure*: 50 to 72 lbs.

Financial.—Cost, $146,000. Capital stock, $144,000. Ann. rev.: city, $4,500. No other data given.

Management.—Prest., W. Warren. Treas., Jno. R. Bullard. Supt., Wm. F. Hill.

EAST BRIDGEWATER, *Plymouth Co.* See Bridgewater and East Bridgewater.

EASTHAMPTON, *Hampshire Co.* (Pop., 4,206; est., 4,300.) Engaged in manufacturing cotton, silk, elastic and rubber goods, buttons and steam pumps.

History.—Built in '73 by town.

Water Supply.—Surface water, direct pumping.

Pumping Machinery.—Dy. cap., 360,000 galls. Owned and operated by Rubber Thread Co., who receive $600 a year for pumping.

Distribution.—*Mains*, c. i., 4 miles. *Services*, iron. *Taps*, 118. *Meters*, not given. *Hydrants*, kind not given, 60.

Consumption, 360,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 110 lbs.

Financial.—Ann. op. exp., $1,100. Ann. rev.: consumers, $1,435. No further data given.

Management.—Five Commrs. Supt., Geo. L. Manchester.

NOTE:—There is considerable talk of building new works.

EVERETT, *Middlesex Co.* (Pop., 4,159; est., 7,000.) Three miles from Boston. Engaged in manufacturing, especially chemicals and wheels.

History.—Supplied in '71 from Mystic Water-Works, Charleston, now a part of the Boston system.

All data included under Boston.

FALL RIVER, *Bristol Co.* (Pop., 48,961; est., 65,000.) On east side of Mount Hope bay, an arm of Narragansett bay. On irregular ground, rising at some points 260 ft. above tide-level. One of the largest cotton manufacturing cities in New England. Has granite quarries near by, and is largely engaged in commerce. Settled in 1659; incorp. a city in '54.

History.—Built in '71-4 by city, the population in '70 having been 26,766. Des. Engr., W. J. McAlpine. Const. Engrs., Geo. A. Briggs, with Wm. Rotch as Asst. Consulting Engr., Jas. P. Kirkwood. Contrs., Jno. Mangan, Salem, and Lobdell & Cornish, New Bedford.

Water Supply.—Watuppa lake, pumping to stand-pipe and tank. Lake is 128 ft. above tide-water, has an area of 5.5 sq. m., storage cap. of 10,000,000,000 galls., mean daily discharge of 35,000,000 galls., and furnishes water-power for manufactories in Fall River.

Buildings.—The engine-house is on coffer-dam 60 ft. from the west shore of lake and 9,472 ft. from main street of city. It is built of granite, laid in rough ashlar, after designs by J. M. Wilson, Architect. The engine-room is 56 by 80 ft., and 34 ft. high. The boiler-room is 23 by 53½ ft., with a chimney 112 ft. high. This chimney was struck by lightning in '85 and so badly damaged that it was found necesssary to tear it down and erect a new one at a cost of $6,000. An interesting description of the accident and the means employed to take down the old chimney is given in *Eng. News*, vol. XVI., p. 118. There is a coal-house 21 by 86 ft. and a granite building divided into tenements for the engineer and his assistant, and with a storage basement below. The gate-house is 8 by 10 ft., with its floor 10 ft. below the lake surface. An arched conduit 6 ft. wide and 4 ft. high conducts water to the engine-house, and there divides into four branches leading to as many pump-wells.

Pumping Machinery.—Pumps furnished by Whittier Machine Co., H. R. Worthington and M. T. Davidson. Most of the pumping in '87 was done by the Worthington and Davidson pumps. Combined dy. cap., 13,000,000 galls.

Stand-Pipes.—Two, enclosed in masonry tower 116 ft. high. Each pipe is 40 ins. in diam.; one is 60 and the other 80 ft. high.

Tank.—Made by Cunningham Iron Works, Boston; 73 ft. in diam. by 73 ft. high, and 305 ft. above tide-water.

Distribution.—*Mains*, c. i., 60 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., R. D. Wood & Co., Philadelphia, Pa., and Gloucester Iron Works, Office, 6 North Seventh St., Philadelphia, Pa. *Taps*, or services, 4,197. *Meters*, 2,941; principally Crown, Union and Gem, with some Worthington. Ball & Fitts and Desper. *Hydrants*, 613; Whittier Machine Co.'s, Pattee & Perkins and Coffin. *Valves*, 617, do.

Consumption.—1,590,960 galls. *Pressure*; ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $1,754,441. Debt, $1,519,491. Int., average, 5.7%. Ann. op. exp., $25,044. Ann. rev.: consumers, $83,425; city, $50,000.

Management.—By Watuppa Water Board, consisting of five members. Prest. Weaver Osborne. Clerk and Registrar, Wm. W. Robertson. Supt., Patrick Kiernan. Inspector of Meters, Saml. Ogden. Pumping Engr., Jno. Lufkin.

NOTE:—A more extended description of these works is given in *Eng. News*, vol. V., pp. 180, 188, 211, 219, 229 and 243; also vol. VIII., p. 264.

FITCHBURG, *Worcester Co.* (Pop., 12,429; est., 18,000.) On Nashua river, which at this point flows through a long narrow valley from which the ground rises on each side 250 ft. Engaged extensively in manufacturing, especially cotton and woolen goods, chairs, engines and machinery. Incorp. a town in 1764, a city in '72.

History.—Built in '71-2 by city. Des. Engr., Phineas Ball, Worcester. Const. Engrs., Geo. Raymond and W. A. Smith.

Water Supply.—Surface water, by gravity from reservoirs. The first supply was from the natural flow of Scott brook, a stream having a drainage area of about 1 sq. m., but there are now several reservoirs fed by brooks and springs. A stream known as Shattuck brook is connected with Scott brook by a 14-in. wrought-iron and cement pipe. This brook is 8,300 ft. distant, and has a drainage area of 1¼ sq. miles.

Reservoirs and Dams.—An impounding reservoir on Scott brook originally covered 36 acres and had a capacity of 109,000,000 galls. It was formed by building an earth dam 46 ft. high, with a heart-wall of rubble masonry and cement; this was afterwards raised and strengthened, increasing the capacity of the reservoir to 200,000,000 galls. Two cast-iron pipes are laid through the dam, one on the natural surface, and the other on stone piers 16 ft. above. These connect with a 24-in. circular brick conduit, 7,916 ft. long, leading to Overlook reservoir, formed by building two dams across a ravine. The upper dam is 22 ft. high and 1,000 ft. long; while the lower dam is 42 ft. high, 400 ft. long, and has a heart-wall of stone 2 ft. thick, pierced with a 12-in. and 16-in. outlet pipe. This reservoir has an area of 13 acres, a capacity of 60,000,000 galls., is 400 ft. above the city, and is used for a high-pressure supply. At a point in the ravine 1,150 ft. distant from the lower dam of Overlook reservoir, another dam, 21 ft. high, forms Marshall reservoir, which has a capacity of 20,000,000 galls., is 200 ft. above the city, and furnishes the low-pressure supply. The two reservoirs can be connected.

Distribution.—*Mains*, c. i., w. i. and cement, 34.7 miles. *Services*, w. i. and cement. *Taps*, 2,203. *Meters*, 600. *Hydrants*, Whittier Machine Co.'s and Chapman, 256. *Valves*, Whitter Machine Co.'s and Chapman.

Consumption, 1,183,500 galls. *Pressure*: Low service, 80 lbs. High service, 160 lbs.

Financial.—Cost, $621,701. Debt, $500,000. Int., average, 5.55%. Ann. op. exp., $12,367. Ann. rev.: consumers, $30,203; city, $15,903. Hydrant rental, $50.

Management.—Three Commrs. Prest., Chas. H. Brown. Supt. and Clerk, Thomas C. Lovell. Registrar, A. W. F. Brown.

FRANKLIN, *Norfolk Co.* (Pop., 4,051; est., 4,500.) Engaged in manufacturing straw, woolen and rubber goods. Incorp. a town in 1778.

History.—Built in '84 by Franklin Water Co., under 25 years' franchise. Des. Engr., F. E. Smith. Const. Engr. and Contr., G. Norman Weaver, Newport, R. I.

Water Supply.—Two wells, pumping to tank. One well is 20 by 30 ft.; the other, 18 by 33 ft.

Pumping Machinery.—Knowles compound duplex condensing pump with 18 and 10-in. steam, and 14 in. water cylinders, and 10-in. stroke; dy. cap., 1,000,000 galls.

Tank.—Built by E. Hodge & Co., East Boston, Mass., of ⅜-in. iron: 30 ft. wide by 80 ft. long, and placed on rock foundation, the site being the same as that of the tank which gave way, Oct., '88.

Distribution.—*Mains*, w. i. and cement, 8 miles. *Services*, w. i. and lead. *Taps*, 270. *Meters*, 6. *Hydrants*, Pattee, 65.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire, 140 lbs.

Financial.—Cost, $125,000. Debt, none. Ann. op. exp., not given. Ann. rev.: consumers, $3,300.; city, $3,405. Hydrant rental, $48 for first 50 and $35 for each additional.

Management.—Prest., J. G. Ray. Treas., G. Norman Weaver, Newport, R. I. Supt., Wm. E. Nason.

GARDNER, *Worcester Co.* (Pop., 4,998; est., 9,000.) Built on high ground in rough country. Incorp. a town in 1785. Has large chair shops.

History.—Built in '82 by Gardner Water Co. Des. Eng., S. L. Wiley.

Water Supply.—Crystal lake, by pumping to reservoir. Lake has area of about 1 sq. m.

Pumping Machinery.—Deane pump, dy. cap., 4,000,000 galls.

Reservoir.—Cap., 3,000,000 galls. Is 100 ft. above pump, and from 100 to 250 ft. above town.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i. *Taps*, 625. *Meters*, 20. *Hydrants*, Ludlow and Pattee, 74.

Consumption, 200,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Stock and bonds, $160,000. No further data given for '88, but in '84 works had cost about $150,000, and debt was $60,000 at 6%.

Management.—Prest., C. H. Green. Supt., H. W. Conant.

GLOUCESTER, *Essex Co.* (Pop., 19,329; est., 22,000.) On Cape Ann. The largest fishing port in the United States. Also engaged in foreign and domestic commerce and production of granite.

History.—Built in '85 by Gloucester Water Supply Co. Engr., G. Norman Weaver, Newport, R. I.

Water Supply.—Wallace and Dyke's ponds, pumping to reservoir.

Pumping Machinery.—Knowles pump, dy. cap., 5,000,000 galls.

Reservoir.—Cap., 10,000,000 galls,

Distribution.—*Mains*, w. i. and cement, 28 miles. *Services*, 735. *Meters*, 30. *Hydrants*, Chapman, 150.

Consumption, 400,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Capital stock, $250,000. Bonds, $250,000. Int., 5 %. Ann. rev.: city, $7,000. Hydrant rental, $46.66.

Management.—Treas., G. Norman Weaver. Supt., Jno. E. McCusker.

GRAFTON and NORTH GRAFTON, *Worcester Co.* (Pop., 4,030; est., 6,000.) Manufactures boots and shoes, cotton and woolen goods.

History.—Built in '86-7 by National Water-Works Syndicate, Boston. Engr., Geo. Alexander, Boston.

Water Supply.—Not given.

Distribution.—*Mains*, 12 miles.

Financial.—Capital stock, $65,000. Bonds, $65,000. Int., 5 %. No further data given.

Management.—Gen. Mgr., B. C. Mudge. Chf. Engr., Geo. Alexander. Supt., Solon F. Smith. Offices, 70 Kilby St., Boston.

GREAT BARRINGTON, *Berkshire Co.* (Pop., 2,715; est., 4,800.) On Hoosatonic river, in a long winding valley enclosed by rocky hills. Engaged in manufacturing, and quarrying variegated marble and blue stone. Settled in 1730; incorp. a village in 1761.

History.—Built in '68 by Great Barrington Water Co.

Water Supply.—Mountain stream, by gravity from reservoir.

Reservoir.—Is 100 ft. above town; formed by dam 8 ft. high and 100 ft. long.

Filter.—At outlet of reservoir there is a stone, gravel and charcoal filter.

Distribution.—*Mains*, c. i., w. i. and cement, 3 miles. *Services*, kind not given. *Taps*, 315. *Meters*, none. *Hydrants*, 21.

Consumption and Pressure, not given.

Financial.—Cost, $28,000. Debt, none. No further data given.

Management.—Prest., Jno. S. Dodge. Secy., H. F. Robbins. Treas., F. T. Whiting.

GREENFIELD, *Franklin Co.* (Pop., 3,903; est., 5,000.) On rolling land one mile from, and 100 ft. above, Connecticut river. Engaged in manufacturing, trade and agriculture. Settled in 1738; incorp. in 1753.

History.—Built in '70 by the fire district. Des. Engr., Alfred R. Field. Const. Engr. and Contr., S. L. Wiley.

Water Supply.—Surface water, by gravity from impounding reservoir.

Reservoir.—Cap., 10,000,000 galls. Has area of 4 acres, drainage area of 8 sq. m. of mountainous country, and is 5 miles from, and 200 ft. above, village.

Dam.—Stone; 60 ft. long, 35 ft. high, 16 ft. thick at bottom and 10 at top.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, 3. *Hydrants*, Mathews, Ludlow and Chapman, 57. *Valves*, kind, do.

Consumption, 400,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Debt, $95,000, of which $60,000 is in bonds, and $35,000 in loans from savings banks. Int., 4 %. Ann. op. exp., $1,500. Ann. rev.: consumers, $11 400; city, none.

Management.—Commrs.: A. A. Rankin, A. Withey and E. A. Newcomb. Supt., C. T. Wiley.

HAVERHILL, *Essex Co.* (Pop., 18,472; est., 25,000.) On Merrimac river at head of tide water, is on hilly ground rising in places 350 ft. above tide level. Incorp. a town in 1645; a city in '70. Engaged in various manufactories, ranking as second city in the United States in the production of boots and shoes.

History.—Built in '01 by Haverhill Aqueduct Co.

Water Supply.—From springs and ponds, by gravity and pumping to stand-pipe. Originally from ponds near the city, the water being distributed through wooden logs. Round pond, of 35 acres area, and 147 ft. above the river, supplied the village for several years; then water was taken from Plug pond, or Lake Saltonstall, of 41 acres area, and 118 ft. above the river; in '70 water was pumped into Round pond from Kenoza lake, the latter having an area of 200 acres at 100 ft. elevation. In '78 water was first pumped from Kenoza lake to stand-pipe to supply the higher parts of the city. The lower levels are supplied by gravity from Lake Saltonstall, and the intermediate levels from Round pond. The western part of the city is supplied by a small stone reservoir at 170 ft. elevation.

Pumping Machinery.—Two Worthington duplex pumps; dy. cap., 2,000,000 galls. each.

Stand-pipe.—Made by Cunningham Iron Works, Boston; 30 ft. in diam., 50 ft. high and 256 ft. above river.

Distribution.—*Mains*, c. i., w. i. and cement, 40 miles. *Services*, lead. *Taps*, 2,800. *Meters*, Worthington, number not given. *Hydrants*, mostly Chapman, 139. *Valves*, mostly Chapman.

Consumption, 1,250,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Stock and bonds, $400,000. Int., 4½ and 5 %. Hydrant rental, free. No further data given.

Management.—Supt., C. W. Morse.

HINGHAM and HULL *Plymouth Co.* (Pop., Hingham, 4,485; est. 5,000, Hull, 383; est., 475.) Both villages on Massachusetts bay, on irregular ground. Hingham was settled in 1630 and is a summer resort 17 miles from Boston.

History.—Built in '80 by Hingham Water Co., and extended to Hull in '82. Engrs., M. M. Tidd, Boston, and C. W. S. Seymour, Hingham. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Accord and Fulling Mill ponds, by gravity, and by pumping to stand-pipe from receiving basin. Accord pond has an area of 98 acres, a drainage area of 365 acres, and is 135 ft., above tide-level. Fulling Mill pond has an area of 14 acres, and is 30 ft. above tide-level. The supply was by gravity until '84 when a pumping station was built. The supply from Fulling Mill pond was added in '86.

Receiving Basin.—Brick and stone, 120 by 50 ft., by 10 ft deep; cap., 350,000 galls. The wall of the basin is of dry rubble stone lined, for the first 4 ft. with stone paving set in cement; sloping 1½ to 1, and the remaining 6 ft. with a nearly perpendicular brick wall, surmounted by a granite coping.

Pumping Machinery.—Deane pump, dy. cap., 1,000,000 galls. Horizontal tubular boilers.

Stand Pipe.—Made by E. Hodge & Co., East Boston; 40 ft. in diam. and 43 ft. high; cap., 395,000 galls. On Strawberry hill, its base being 90 ft. above tide-level.

Distribution.—*Mains*, w. i. and cement, 40 miles. *Services*, w. i. and cement. *Taps*, 1,000. *Meters*, 2. *Hydrants*, mostly Chapman, 150. *Valves*, mostly Chapman.

Financial.—Cost, $225,000. Capital stock, $12,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $18,000; city, $2,250. Hydrant rental, $15 each, or 10% a year on cost of works.

Management.—Prest. Ebed L. Ripley. Treas., Starkes Whiton. Supt. C. W. S. Seymour.

HOLBROOK, *Norfolk Co.* (Pop., 2,130; est., 3,500.)

History.—Built in '87-8 by town. The stand pipe and pumping station, and mains between, are owned jointly by Holbrook and Randolph and operated as the Randolph and Holbrook Water-Works under one management.

Water Supply.—Lake in Randolph and Braintree, by pumping to stand-pipe 112 ft. high by 30 ft. in diam.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i. and cement. *Taps*, 200. *Meters*, none. *Hydrants*, Chapman, 65. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*: Ordinary, 78 lbs. Fire, 78 lbs.

Financial.—Cost, $95,000. Int., 4%. Ann. rev.: consumers, $2,500. Hydrant rental, $35. No further data given.

Management.—Supt. E. J. Chadbourn.

Note:—See Randolph for further details.

HOPEDALE, *Worcester Co.* (Pop., est., 2,000.)

History.—Supplied in '82 by Milford Water Co.

Distribution.—*Mains*, c. i., 2¾ miles. *Services*, lead. *Taps*, 118. *Meters*, 5. *Hydrants*, Chapman, Ludlow and Mathews, 15. *Valves*, kind, do.

Financial.—Cost, $17,000. Ann. exp. to Hopedale village, $596.

Note:—See Milford for further details. Above items are included in figures for those works.

HOLYOKE, *Hampden Co.* (Pop., 21,915; est., 31,500.) On west bank of Connecticut river at point where river falls 60 feet in ¾ miles, affording a water-power that was developed for manufacturing in '49. City is laid out regularly on high ground. Incorp. as West Springfield in 1786, as separate town in '50 and as a city in '73.

History.—Built in '73 by city, when population was only 14,000. Consulting Engrs., Shedd & Sawyer, Boston. Const. Engr., E. C. Chase, Northampton.

Water Supply.—Wright's and Ashley's ponds, 3½ miles from city, connected by a canal and two mountain streams; by gravity. The area of the two ponds is about 240 acres and their drainage area 2.7 sq. m. of hilly land composed of gravel and ledges of slate and trap-rock. The ponds are fed by large subterranean springs, and the water is of good quality.

Gate House.—Size, 18 by 24 ft.; at head of Wright's pond, from which water is conducted to city through 19,000 ft. of 20, 16 and 12 in. cast-iron mains, varying in size according to pressure.

Distribution.—*Mains*, c. i., and w. i., 42.4 miles. *Services*, w. i. and cement, enam. and rubber lined iron. Pipes and specials furnished by Jesse W. Starr & Sons, Camden, N. J. Pipe laid by E. B. Allen & Co., New Britian, Conn. *Taps*, 2,713. *Meters*, 149; Worthington, Crown, Ball & Fitts and Desper. *Hydrants*, 274; Ludlow, Chapman, Holyoke and R. D. Wood & Co.'s. *Valves*, kind, do.

Consumption, 2,246,622 galls. *Pressure*: Ordinary, 72 lbs. Fire, 72 lbs.

Financial.—Cost, $480,373. Bonded debt, $250,000. Sinking fund, $100,000. Int., 6%. Ann. op. exp., $8,743. Ann. rev.: consumers, $54,357; city, $3,277. Hydrant rental, $3,000 allowed for fire purposes.

Management.—Three Commrs. Registrar, E. P. Clark. Supt., Jno. D. Hardy. Inspector, E. M. Bolton. Pumping Engr., E. A. Ellsworth.

HOPKINTON, *Middlesex Co.* (Pop., 4,607; est., 3,922.) Manufactures boots.

History.—Built in '84 by town. Engr., C. H. Pierce, Providence, R. I.

Water Supply.—Three artesian wells, pumping to tank. The wells are respectively, 75, 65 and 57 feet deep, 73 ft. of the first, 57 of the second and 37 feet of the third being forced through solid rock.

Pumping Machinery.—Deane pump, dy. cap., 36,000 galls.

Tank.—Iron, 35 feet in diam., 35 ft. high and located 142 feet above lowest part of town; cap., 250,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 140. *Meters*, 7. *Hydrants*, kind not given, 33.

Consumption, 20,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $35,000. Debt, $32,000. Int. 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,700; city not given.

Management.—Water Board. Report made by J. A. Woodbury.

HUDSON, *Middlesex Co.* (Pop., 3,739; est., 4,000.) Engaged in manufacturing shoes and rubber goods.

History.—Built in '84 by town. Engr., M. M. Tidd, Boston. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Gates pond, by gravity. Area of pond, 75 acres.

Distribution.—*Mains*, w. i. and cement, 11 miles. *Services*, w. i. and cement. *Taps*, over 300. *Meters*, 1. *Hydrants*, Chapman and Holyoke, 85. *Valves*, Chapman and Holyoke.

Consumption, 100,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $87,000. Debt, $80,000. Int., 4%. Ann. op. exp., $3,800. Ann. rev.: consumers, $4,800; city, $1,500.

Management.—Supt., D. W. Stratton.

HULL, *Plymouth Co.* (Pop., 383; est.,475)

History.—Supplied in '82 by Hingham Water Co. All data included under Hingham.

HYDE PARK, *Norfolk Co.* (Pop., 7,088; est., 10,000.) Engaged in manufacturing paper, cotton and woolen goods, curled hair and machinery.

History.—Built in '85 by Hyde Park Water Co. Engr., M. M. Tidd, Boston.

Water Supply.—Driven wells, pumping to reservoir. About 100 wells, 2 ins. in diam., and from 25 to 38 ft. deep, are connected with a suction pipe. Contr., Calvin Horton & Son, Somerville.

Pumping Machinery.—Blake pump, dy. cap., 1,500,000 galls., against 220 ft. head.

Reservoir.—Cap., 1,500,000 galls. Contrs., Willcutt & Perkins, Boston.

Distribution.—*Mains*, w. i., 22 miles. *Services*, w. i. and cement. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,000. *Meters*, 30. *Hydrants*, Chapman, 104. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*: Ordinary, 86 lbs. Fire, 86 lbs.

Financial.—Cost, $150,000. Capital stock, $100,000. Debt, none. Hydrant rental, $50. No further data given.

Management.—Prest., Robt. Bleakie, Treas. and Clerk, C. F. Allen. Supt., A. S. Adams.

KINGSTON, *Plymouth Co.* (Pop., 1,524; est., 1,572.) On irregular ground; settled in 1630.

History.—Built in '86 by town. Des. Engr., A. H. Howland, Boston. Const. Engr., W. C. Boyce, Worcester. A supply for domestic use only, was introduced by a private company in '04, after plans by Barstow Cook. Water was pumped to the height of 100 ft. from a hill-side spring. The pump had a 3½-in. bore, an 11-in. stroke, and was driven by water-power. There were 2 miles of pipe supplying 50 families. The pipe was first of wood, then iron, then lead.

Water Supply.—Well, by direct pumping, the surplus water passing to reservoir.

Well.—Brick lined, 20 ft. in diam., and 18 ft. deep, which yields about 70,000 galls. a day.

Pumping Machinery.—Dy. cap. 328,320 galls.; Blake duplex power pump with 5-in. cylinders having 12-in. stroke; driven by 30-in. Burnham turbine of 17 H. P.

Reservoir.—Brick, with concrete bottom, 50 ft. in diam. and 18 ft. deep; cap., about 265,000 galls.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. The mains were furnished by the McNeal Pipe & Foundry Co., Burlington, N. J., and the services by the Chadwick Lead Works, Boston. The pipe was laid by Thos. F. Maney & Co., Boston. *Taps*, 145. *Meters*, none. *Hydrants*, Coffin, 56. *Gates*. Coffin. *Gate boxes*, furnished by A. W. Morgan, Buffalo, N. Y. *Stop-cocks*, furnished by Walworth Manufacturing Co., Boston.

Consumption, 20,000,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, 40,000. Debt, 40,000. Int., 4%. Ann. op. exp., not given. Ann. rev.: consumers, $1,500; city, none.

Management.—Three Commrs. Supt., Melvin C. French.

LANCASTER, *Worcester Co.* (Pop., 2,003: est., 2,500.)

History.—Built in '85 by Lancaster Water Co., under a 15 years' franchise. Engr. and Contr., J. T. Langford, 70 Kilby St., Boston.

Water Supply.—Clinton Water-Works, the town of Clinton superintending the works and collecting the rates.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. and cement. *Taps*, 100. *Meters*, Crown, 10. *Hydrants*, Chapman, 25. *Valves* Chapman.

Consumption, Not given. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Capital stock, $20,000. Bonded debt, $20,000. Int., 5% Hydrant rental, $50. No further financial data given.

Management.—Prest., E. V. R. Thayer. Treas., J. T. Langford. Supt., J. F. Philbin of the Clinton Water-Works.

LAWRENCE, *Essex Co.* (Pop. 39,151; est., 40,000.) On Merrimac river. Founded in '45 as a manufacturing town, the river affording an excellent water-power.

History.—Built in '73 5 by city, the population in '70 being about 30,000. Des. Engr., L. F. Rice. Consulting Engr., Jas. P. Kirkwood, Brooklyn, N. Y. Chf. Engr. of Const., Walter F. McConnell, Boston.

Water Supply.—Merrimac river, pumping to reservoir and direct.

Intake Pipe.—A 36-in. cast-iron pipe has its inlet-end cased in stone masonry at a point in the river where the water is about 12 ft. deep. The pipe extends 132 ft. to a brick conduit 38 ft. long connecting with a chamber discharging into the pump-well.

Filter Galley.—Near river bank, 300 ft. long, with bottom 15 ft. below surface of river; has rubble masonry walls 4 ft. high and 8 ft. apart, and is covered with a semicircular brick arch. At the bottom are cross-braces of granite, 1 ft. sq. and 10 ft. apart, filled between with broken stone. In '76 a canal was cut between the gallery and the river, which increased the supply somewhat. The canal and gallery are leaned each year. Both the filter galley and river inlet discharge into a chamber from which the water is delivered to the pump-well. Water can be taken either from the filter gallery or direct from the river, or both at once, as may be desired.

Pumping Machinery.—Two pumps, dy. cap., 5,000,000 galls. each, built by I. P. Morris & Co., at the Port Richmond Iron Works, Philadelphia, Pa., after designs and under patent of E. D. Leavitt, Jr., Cambridge.

Buildings.—Architect, Chas. J. Emerson; consist of engine-house, boiler-house and coal-shed, all connected and continuous. Built of face brick with freestone trimmings and slate roofs, except the coal-shed, which has its roof level with the ground and is constructed of brick arches laid on wrought iron girders, these covered with a layer of gravel and a second layer of concrete. The foundations are of rubble masonry laid in hydraulic cement, and extend 22 ft. below the floor line of the basement. The interior dimensions are: engine house, 62 ft. sq. and 52 ft. high: boiler-room, 45 by 51⅜ ft. and 38 ft. high; coal-shed, 59¾ by 58 ft. and 12 ft. high, having a storage capacity of 800 tons. The main floor of the engine-house is of heavy Southern pine timbers covered with 4-in. planks and 1⅝-in. boards, both of Southern pine. The buildings are heated by steam.

Chimney.—Has height of 138 ft. above floor line; a foundation of 12 ft. of heavy stone masonry laid in cement, surmounted by granite blocks in courses to the height of 15 ft. above floor-line, where brick-work begins and extends 123 ft. Above the foundation its greatest diameter is 14 ft., 2 ins., and its smallest, 9 ft., 5 ins. The core extends from bottom of floor to within 12 ft. of top of chimney, is 4 ft. in diameter and surrounded by an air space.

Force Main.—To reservoir; 30-in. cast-iron, 5,000 ft. long, passing for 900 ft. through an egg-shaped tunnel of hard burned brick laid in cement, 6 ft. high and 7 ft. wide with well and manhole at each end. Just after entering reservoir a 20-in.

branch leads from the force to the distributing main.with which it is connected in such a way that direct pumping can be used, or water pumped directly into the gate-chambers for distribution without pumping against the head of water in the reservoir.

Reservoir.—Cap., 40,000,000 galls.: in two compartments, each being 375 by 338 ft. and 25 ft. deep. Built in excavation and embankment, the latter being 27 ft. wide on top, with inner slopes 1½ to 1 and outer slopes 2 to 1, making the base 125 ft. thick. Where needed for strength there are lower, supplementary banks, 20 ft. thick. Natural banks are lined with 2 ft. of puddle, and artificial banks have a puddle wall in the center beginning from 8 to 10 ft. below the bottom of the reservoir with a width of 12 ft. and being stepped 1 ft. in every 5 until within 2 ft. of the top of the bank. The bottom of the reservoir is covered with 2½ ft. of puddle, above which is first a layer of gravel, then round cobble stone paving. The slopes are paved with rubble stone, upon a layer of crushed stone.

Overfall.—The force main extends upwards through the central bank, or dividing wall, of the reservoir, turns, and discharges water through a bell-shaped pipe upon a stone platform, from which the water falls over 6 granite steps, 10 ft. wide, into each compartment of the reservoir, or by use of flash boards, into but one compartment. This method breaks up the water, and causes it to be aerated.

Gate House.—Brick, 30 ft. sq. and 20 ft. high, with granite foundations beginning 11 ft. below the bottom of the reservoir, where they are 40 ft. sq. In the gate-house are one large and two small wells, into which water is brought from the reservoir. These are connected with the distribution mains by two 30-in. pipes carried through a gate vault and tunnel and uniting in a T joint.

Distribution.—*Mains*, c. i., 53.6 miles. *Services*, lead. *Taps*, 4,447. *Meters*, principally Crown, Union and Worthington, 918. *Hydrants*, Chapman, Whittier Machine Co.'s, 496. *Valves*, kind, do.

Consumption, 2,500,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $1,953,840. Debt, $1,300,000. Sinking fund, $388,078. Int., 6%. Ann. op. exp., $23,242. Ann. rev.: consumers, $89,459.

Management.—Fire Commrs.: Prest., Jos. E. Watts. Registrar, Herbert F. Whittier. Clerk and Supt., A. H. Salisbury.

NOTE:—For more extended description see *Eng. News*, vol. V., pp., 283, 291, 300.

LEE, *Berkshire Co.* (Pop., est., 1,500.) On Hoosatonic river, on very irregular ground. Settled in 1760; incorp. a town in 1776.

History.—Built for domestic supply in '81 by Berkshire Water Co. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Mountain stream, by gravity from impounding reservoir. Stream has drainage area of 6 sq. m.

Reservoirs.—Impounding, cap., 20,000,000 galls. Distributing, cap., 1,500,000 galls.; 212 ft. above village.

Distribution.—*Mains*, w. i. and cement, 3 miles. *Services*, w. i. *Taps*, (in '86) 100. No meters or hydrants.

Consumption, unknown. *Pressure*: 85 lbs.

Financial.—Cost, (in '86) $30,000. Capital stock, $20,000. Bonded debt, $20,000, Int., 6 %. Ann. op. exp., $400. Ann. rev.: consumers, $2,500.

Management.—Treas., Thos. N. Birnie. Supt., J. C. Chaffee.

LENOX, *Berkshire Co.* (Pop., 644; est., 700.) On a hill, 1,200 ft. above tide-level, in center of Hoosatonic valley, surrounded by mountains. Settled about 1750; incorp. a town in 1767.

History.—Built in '75 by private company. Engr., Geo. Murdock.

Water Supply.—Springs and river, by gravity from impounding reservoirs and by pumping to reservoirs in case of need.

Reservoirs.—Three stone dams, laid in cement, form as many reservoirs, holding 40,000, 500,000 and 165,000 galls., respectively. The latter is 100 ft. above the village and is used as a distributing reservoir.

Filters.—Of stone and gravel.

Pumping Machinery.—Cameron pump, cap. not given, lifts water 190 ft. from river to reservoir.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 8.

Consumption, 45,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $26,000. Capital stock, $22,000. Debt, none. Hydrant rental, free. No further data given.

Management.—Prest., J. Rockwell. Treas., Wm. D. Curtis. Commr., C. R. Bond.

LEOMINSTER *Worcester Co.* (Pop., 5,772; est., 6,000.) On Nashua river and Monoosnock brook, on undulating ground, the eastern portion being sandy and the western hilly. Manufactures paper, jewelry, buttons, pianos and horn combs. Settled in 1725; incorp. in 1740.

History.—Built in '73 by town. Engr., C. E. Lund, deceased, Concord, N. H. Contrs., Goodhue & Birnie, Springfield, Mass.

Water-Supply.—Morse and Haynes brooks, by gravity from impounding and distributing reservoirs. The brooks have a combined drainage area of about 2 sq. miles.

Reservoirs.—On Haynes brook: formed by earth dam, with heart wall of stone masonry, 15 ft. high and 698 ft. long. Cap., 150,000,000 galls. On Morse brook: covers 20 acres; cap., 10,000,000 galls. Distributing reservoir: formed on a stream by an earth dam, with heart wall of stone masonry, 23 ft. high and 304 ft. long, and a waste-way of stone masonry, 25 ft. wide. Two 14-in. cast iron pipes convey the water through the latter dam from a gate chamber just inside the reservoir.

Distribution.—*Mains*, c. i, w. i. and cement. *Services*, w. i. and cement. *Taps*, 933. *Meters*, none. *Hydrants*, kind not given, 138. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: 80 to 125 lbs.

Financial.—Cost, $160,000. Debt, $160,000. Int., 4, 6 and 7 %. Ann. op. exp., $1,681. Ann. rev.: consumers, $12,744: city, $4,000. Hydrant rental, $50.

Management.—Board of Commrs. Supt., J. G. Tenney.

LEXINGTON, *Middlesex Co.* (Pop., 2,400; est., 2,800.)

History.—Built in '84 by Lexington Water Co. Office, 105 Summer St., Boston. Eng., Moses Joy, Jr.

Water Supply.—Ground water, pumping to tank.

Pumping Machinery.—Blake duplex pump, dy. cap., 600,000 galls.

Tank.—Made by H. B. Bigelow & Co., New Haven, Conn.; 20 ft. in diam., 35 ft. high.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead. Pipes and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and A. H. McNeal, Burlington, N. J. *Taps*, 580. *Meters*, 1. *Hydrants*, Ludlow, 49. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Stock, $60,000. Bonds, $20,000. Hydrant rental, $33.33 for first 30; additional, $30. Further data withheld.

Management.—Prest., Moses Joy, Jr. Secy., C. E. Tingley, 105 Summer St., Boston. Supt. and Treas., E. L. Wires.

LINCOLN, *Middlesex Co.* (Pop., 907; est., 900.) In hilly, agricultural region 14 miles from Boston. Settled in 1747; incorp. a village in 1754.

History.—Built in '75 by town, Engr., M. M. Tidd, Boston.

Water Supply.—Sandy pond, pumping to reservoir. Pond has area of 154 acres.

Pumping Machinery.—Locomotive boiler and Worthington duplex pump; dy. cap., 100,000 galls.

Distribution.—*Mains*, w. i. and cement, 3.5 miles. *Services*, w. i. and cement. *Taps*, 40. *Meters*, none. *Hydrants*, Newport, 11.

Consumption, not given. *Pressure*: not given.

Financial.—Cost, $35,000. Debt, $30,000. Int., 6%. Ann. op. exp., $800; Ann. rev.: consumers, $800; city, $1,800.

Management.—Supt., Geo. L. Chapin.

LOWELL, *Middlesex Co.* (Pop., 59,475; est., 70,000.) On Merrimac river. Business part of city is low and flat, but environs are elevated. At this point the river descends rapidly, bringing down the drainage of 4,136 sq. m. and affording most excellent water-power, which is used for various manufactories; the largest cotton mills in the United States are here. The first mill was erected in '22, and the city was incorp. in '36.

History.—Built in '72 by city, the population in '70 having been 40,000. Des. Engr., Geo. P. Davis. Const. Engr., Geo. E. Evans. Before the construction of these works several lines of wrought iron and cement pipe had been laid by the city for fire protection, and these were incorporated in the distribution system.

Water Supply.—Merrimack river, pumping to reservoir.

Filter Galley.—Excavated in gravel when works were built; parallel to and 100 ft. from river, 1,300 ft. long and 8 ft. wide, with bottom level with dam across river at this point. Rubble masonry walls 5 ft. high support a semicircular brick arch. At the bottom are cross braces of granite, 1 ft. sq., placed 10 ft. apart and filled between with coarse screened gravel. The walls and arch are laid in cement mortar. Three manholes are carried to the surface of the ground above. The ground water from a narrow tract of intervale land from 300 to 3,000 ft. wide, and underlaid with a mixed stratum of gravel and sand, enters the gallery from the bottom. Water can be drawn directly from the river through a 30-in. cast iron pipe leading to an inlet chamber 17½ by 38⅛ ft., with a wing 13⅛ by 15⅛ ft., with walls of cut granite laid in cement. The inlet pipe is 220 ft. long, extends 45 ft. into the river where it is strapped to a grillage of piles. A screen and gate is placed at the outer end and a second gate 136 ft. from the chamber. In '73 it was found, by tests, that the yield of the filter gallery was 150 galls. in 24 hours, per sq. ft. of bottom area. In '75 the consumption exceeded the yield of the filter so that water was taken directly from the river. It was decided to augment the yield by constructing a filter bed.

Filter Bed.—Built in '76 in gravel between the filter gallery and the river; 100 by 114 ft. at bottom, which is 8 ft. below the level of Pawtucket dam. On the gravel is laid a dry stone drain, 15 in. sq. at the river end and 30 in. sq. at the end nearest the gallery, where it terminates in 10-ft. circular brick chamber, connected with the filter gallery by a 30-in. pipe. From the central drain 27 lateral stone drains are laid, each 8 by 12 in. All the drains are covered with 36-in. of from 8 to 3-in. cobble stone, then with 10-in. of from 2 to 1-in. screened gravel, then with 6-in. of coarse, screened sand and finally with 18 in. of fine sand.

In the spring of '77 a freshet deposited 18 in. of sand and silt on the filter bed, and it was necessary to admit some water directly from the river until the deposit was removed in Sept., when for 83 days the filter bed and gallery yielded the full supply to the city of 1,750,800 galls. In '78 the filters furnished the full daily supply of 1,879,810 galls. for 43 days. It was found that with a 1 in. silt deposit the filter yielded but little water. From Aug., '78, to June, '79, the surface of the bed was not cleaned, and in this time 20 in. of silt had accumulated. After being cleaned it supplied the gallery for only 9 days before another inch of silt entirely stopped the yield. Finding that the bed needed cleaning 3 times a month, that the cost would be $25 each time, and that it could only be done when the river was low and free from ice, further cleaning was given up and the filter bed has since been practically useless, four fifths of the water used now being pumped directly rom the river.

Conduit.—Leading from filter galleries and inlet chamber to engine house. First 4,133 ft. is a 51-in circular brick conduit laid in cement. Of this, 1,788 ft. is through a rock tunnel 4 ft. sq. and lined with brick for 733 ft. This brick conduit terminates in a chamber from which a 30-in. cast-iron pipe is laid 6,554 ft. to the engine-house. The pipe crosses Beaver brook and for 100 ft. it was laid on the bed of the stream in a coffer-dam. At the lowest point in the pipe-conduit there is a manhole 14 ft. long with a 6-in. blow-off pipe 3½ ft. below its top. The pipe-conduit terminates in an arched pocket, 35.5 by 10 ft., over which is the foundation for the pumping engine, the whole resting partly on timber foundations and partly on rubble masonry supported on 82 piles driven 20 ft. A passage in the engine foundation leads from the pocket to the pump well, which is 13 by 35 ft. and 18.17 ft. deep.

Pumping Machinery.—Morris and Worthington; combined dy. cap., 10,000,000 galls. The first pumping engine was made by Henry P. Morris and was a beam and fly-wheel compound, condensing engine, with low-pressure cylinder of 57 in. diameter and 96 in. stroke and a high-pressure cylinder of 36 in. diameter and 61⅝ in. stroke. The pump is a Thames-Ditton, with a 36-in. bucket and 25.45-in. plunger of 60-in. stroke, and has a dy. cap. of 5,000,000 galls. In '75 a 5,000,000 Worthington compound duplex engine was erected.

Force Main.—To reservoir 2,666 ft. from and 157 ft. above pumps; a 36-in pipe.

Reservoir.—Cap., 30,000 galls.: in excavation and embankment, 510 by 520 ft. and 24 ft. deep. The banks are built of puddling gravel built up in 6-in. layers, wetted and rolled. The inner slopes are lined with 2-ft. of puddle on which is 10-in. of broken stone covered with a 15-in dry granite paving. The bottom is covered with 12 in. of puddle. In '72 the reservoir was emptied for cleaning for the first time, when about 75 ft. of slope paving fell down.

Distribution.—*Mains*, c. i., 83 miles. *Services*, w. i., lead. *Taps*, 7,440. *Meters*, 1. 30; mostly Desper, Worthington and Crown, with a few Ball & Fitts and Duplex. *Hydrants*, Ludlow, 758. *Valves*, Chapman.

Consumption, 4,319,164 galls. *Pressure*: Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $4,270,303. Debt, $1,890,000. Int., 6%. Ann. op. exp., $33,527. A . rev.: consumers, $178,234.

Management.—Five Commrs. Supt., Robt. J. Thomas. Pumping Engr., Lewis Stiles. Meter Inspector, Robt. Gardner.

LYNN, *Essex Co.* (Pop., 38,274; est., 51,400.) On north side of Massachusetts bay, mostly on flat land, with marshes in front of it, and a range of hills about 1½ miles in the rear, a spur from which enters the city and rises to the height of 185 ft. The great center of shoe manufacturing in the United States. Settled in 1629; incorp. a city in '50.

History.—Built in '70-2 by city, when the population was 30,000. Engr., Geo. H. Bishop, Middleton, Conn. Contr., Geo. H. Norman, Newport, R. I. The town of Saugus has its water supply from these works.

Water Supply.—Breed's and Birch ponds and two brooks in North Saugus, pumping to reservoir. These ponds were formed by building dams across streams; their combined storage capacity is about 540,000,000 galls.

Pumping Machinery.—Dy. cap., 5,000,000 galls. Made by I. P. Morris & Co., Philadelphia, Pa. An E. D. Leavitt's compound beam and fly-wheel engine, with 17½-in. cylinder for high-pressure and 36-in. for low-pressure, drives a Thames-Ditton pump with a 36.12-in. bucket and an 18.5-in. plunger, each having an 84-in. stroke. There is also a 3,000,000 gall. Deane pumping engine, kept for reserve and supplementary use. Water is brought to the engine-house by a 20-in. wrought iron and cement pipe, and forced to the reservoir through 1,904 ft. of the same.

Reservoir.—Cap., 20,000,000 galls. On Pine hill, 177 ft. above mean high tide, with 5 acres of water surface and depth of 15 ft.; built in excavation and embankment. The bottom apparently being of water-tight material was not puddled at first, but when the reservoir was filled it leaked so badly that it was almost useless. In '73 it was made 3 ft. deeper and covered with 1 ft. of clay puddle. The reservoir was then divided by a stone wall with a rubble core.

Distribution.—*Mains*, w. i. and cement, 81 miles. *Services*, w. i. and cement. *Taps*, 7,800. *Meters*, 236. *Hydrants*, Whittier Machine Co.'s, 590. *Valves*, Whittier Machine Co.'s.

Consumption, 2,379,031 galls. *Pressure*: Ordinary, 62 lbs. Fire, 62 lbs.

Financial.—Cost, $1,372,471. Debt, $1,083,395. Int., 4 and 6%. Ann. op. exp., $21,952. Ann. rev.: consumers, $112,147: city, $11,360.

Management.—Water Board of five. Prest., D. H. Sweetser. Supt., Dan'l Walden. Registrar, Frank McCullough. Pumping Engr., W. H. Messinger.

MALDEN, *Middlesex Co.* (Pop., 12,017; est., 19,000.) On Malden river, a tributary of Mystic river; southern part of village on level, and northern part on hilly ground. Engaged in manufacturing. Settled in 1634.

History.—Built in '69 by city. Engr., A. F. Sargent. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Spot pond, by gravity and pumping to stand-pipe. Pond is 139 ft. above tide-level, has an area of 260 acres, a drainage area of 1,100 acres, and is owned by towns of Malden, Medford and Melrose, each of which draw their supply from the pond.

Pumping Machinery.—Blake pump, dy. cap., 1,000,000 galls. Two boilers made by Whittier Machine Co., Boston.

Stand-Pipe.—Used to add small additional pressure to gravity supply; 12 ft. in diam., 45 ft. high.

Distribution.—*Mains*, cement-lined sheet iron, 51 miles. *Services*, lead. *Taps*, 3,580. *Meters*, 51. *Hydrants*, mostly Chapman, 230. *Valves*, mostly Chapman.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 65 lbs.

Financial.—Cost, $492,871. Debt, $440,000. Int., 3½, 4, 5 and 6%. Ann. op. exp., $36,822. Ann. rev.: consumers, $51,822. Hydrant rental, free.

Management.—Three Commrs. Supt., Solon M. Allis. Registrar, Geo. W. Barrett. Inspector, H. A. Hawes.

NOTE:—An additional supply is proposed, and test wells have been sunk in Eaton's meadow, but nothing has been decided on yet.

MANSFIELD, *Bristol Co.* (Pop. 2,765; est., 2,950.) Manufactures straw hats, bonnets and jewelry.

History.—Built in '88 by town. Des. Eng., Percy M. Blake, Hyde Park. Const. Engr., L. L. Serry, Stoneham. Contr. for buildings, R. A. Woodbury, Pawtucket, R. I.

Water Supply.—Cate springs, direct pumping and pumping to stand pipe.

Pumping Machinery.—Two compound condensing duplex Blake pumps, dy. cap., 600,000 galls.

Stand-Pipe.—Made by E. Hodge & Co., East Boston; 20 ft. in diam., 103 ft. high.

Distribution.—*Mains*, c. i., miles not given; furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and laid by Jno. T. Langford, Boston.

Financial.—Capital stock and bonds, $75,000.

Management.—Three Commrs.: D. S. Spaulding, A. B. Day and W. B. Rogerson.

NOTE:—These works were not finished at time of report, hence its incompleteness.

MARBLEHEAD, *Essex Co.* (Pop. 4,467; est 7,550.) On Atlantic coast and is a summer resort. Manufactures children shoes, is also engaged in fishing and seed growing.

History.-Built in '85. The town owns the distribution system and the Marblehead Water Co. the wells, pumping plant, stand-pipe and mains connecting the two latter. This company also supplies Swampscott and Nahant through distribution systems owned by the towns. The pumping-plant is in Swampscott. Engr., A. H. Howland, Boston, Contr., W. C. McClallan, U. S. Hotel, Boston.

Water Supply.—Tubular wells, pumping to stand-pipe.

Pumping Machinery.—Two Deane pumps, dy. cap., 1,000,000 galls. each.

Stand Pipe.—22½ ft. in diam., 110 ft. high.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, kind not given. *Taps*, 125. *Meters*, none. *Hydrants*, Chapman, 70. *Valves*, Chapman.

Consumption, 150,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost $75,000. Capital stock, $75,000. Bonds, $75,000.

Management.—Of Co.: Prest., Thomas Appleton. Supt., Kendall Pollard.

MARLBORO, *Middlesex Co.* (Pop. 10,127; est., 12,000.) Engaged in manufacing boots and shoes.

History.—Built in '83 by town. Engr. M. M. Tidd, Boston.

Water Supply.—Lake Williams, direct pumping and pumping to reservoir.

Pumping Machinery.—Blake compound condensing pump, dy. cap., 2,500,000 galls.

Reservoir.—275 by 230 ft., 18 ft. deep.

Distribution.—*Mains*, c. i., 23 miles. *Services*, w. i. and cement. *Taps*, 1350. *Meters*, 97. *Hydrants*, Chapman, 226. *Valves*, Chapman.

Consumption, 256,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $235,000. Debt, $235,000. Sinking fund, $20,000. Int., 4%. Ann. op. exp., $3,500. Ann. rev.: consumers, $17,000; city, none.

Management.—Three Commrs, Supt., Geo. A. Stacy.

MAYNARD, *Middlesex Co.* (Pop., 2,291; est., 3,000,) On Assabet river. Has woolen mills.

History.—F. W. Wyman, Water Commr., reported Aug. 26 that work would begin Sept. 1, and be finished Dec. 1, '88. The town to build the works, surveys having been made by Wm. Ellis, and A. H. Howland of Boston to have entire charge.

Water Supply.—White pond, 2¾ miles from town, by pumping to reservoir. The latter to have 200 ft. head.

Financial.—Est. cost, 75,000. Not decided, at time of report, how capital for construction would be secured.

Management.—Chairman Water Board, William Ellis, who made report.

MEDFORD, *Middlesex Co.* (Pop. 7,573; est. 9,300.) On Mystic River, in valley surrounded by high hills. is 5 miles from Boston, and has some manufactories. Settled and incorp. as a town in 1630.

History.—Built in '70 by city. Engrs., Sheild & Sawyer, Boston. Contr., Geo. H. Norman, Newport, R.I.

Water Supply.—Spot pond, by gravity and pumping to reservoir. Pond is owned by Medford, Malden and Melrose, and supplies each town; it has an area of about 260 acres, a drainage area of 1,100 acres, is 139 ft. above tide-level and 130 ft. higher than the town.

Pumping Machinery.—Kind not given.

Reservoir.—Used only when water is low in pond; 120 by 23 ft.

Distribution.—*Mains*, w. i. and cement, 37½ miles. The water department has lined its own pipes for 15 years. *Services*, w. i. and cement, galv. i. *Taps*, 1,875. *Meters*, 9. *Hydrants*, Chapman, Coffin and Whittier Machine Co.'s, 181. *Valves*, kind, do.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $330,000. Debt, $300,000. Int, 6%. Sinking fund, $75,107. Ann. op. exp., $6,771. Ann. rev.: consumers, $23,955; city, $2,400.

Management.—Five Commrs. of Sinking Fund. Supt. R. M. Gow.

MELROSE, *Middlesex Co.* (Pop., 4,560: est., 7,100.) In valley surrounded by hills. Has large shoe factory and rubber works. Settled in 1650; incorp. a town in '50.

History.—Built in '70 by city, Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Spot pond, by gravity and pumping to reservoir. Pond also supplies Malden and Medford; is 139 ft. above tide-level, 143 ft. above village, has an area of 260 acres and a drainage area of 1,100 acres.

Pumping Machinery.—Knowles, dy. cap., not given.

Reservoir.—Cap. not given.

Distribution.—*Mains*, w. i. and cement, 25.4 miles. *Services*, enam. i. *Taps*, 1,694. *Meters*, 2. *Hydrants*, kind not given, 123.

Consumption, not reported. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $252,942. Debt, $174,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $19,169: city, $2,000.

Management.—Supt., Parker Merrill.

METHUEN, *Essex Co.* (Pop., 4,392; est., 4,550.) Engaged in manufacturing cotton and woolen goods, boots and shoes; has large agricultural interests.

History.—Built for fire protection in '76 by village.

Water Supply.—Source not given; direct pumping by three pumps in mills.

Distribution.—*Mains*, kind not given, 1 mile. *Hydrants*, kind not given, 95. *Pressure*: 200 lbs.

Financial.—Cost, $6,000. Debt, none. Ann. op. exp., none.

Management.—Chf. Fire Dept., G. B. Bradbury.

MIDDLEBOROUGH, *Plymouth Co.* (Pop. of fire district, est., 3,000.) On Nemasket river. Engaged in manufacturing.

History.—Built in '85 by fire district. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Well, by direct pumping and pumping to stand-pipe. Well is in gravel beds underlying meadows adjoining Nemasket river: circular, 26 ft. in diam. by 22 ft. deep, and consists of heavy stone wall lined with from 12 to 16 in. of brick. Contrs. for well, Putterill & Killian, Boston. Supply is from well, direct, when engine is running, and at all other times from stand-pipe, which is at opposite end of distribution system, thereby causing water to pass through pipes from both directions, alternately.

Pumping Machinery.—Two tubular boilers made by Whittier Machine Co., Boston, and two Deane pumps; dy. cap., 864,000 galls. each.

Engine House.—Architect, Ernest N. Boyden, Boston. Contr., Q. A. Faunce, Quincy.

Stand-Pipe.—Cap., 235,000 galls.; 20 ft. in diam., 103 ft. high, 8,9:7 ft. from, and with top 188 ft. above, pumping station. Water is pumped into the top and drawn from the bottom. Built by H. S. Robinson, East Boston.

Distribution.—*Mains*, c. i., 9.6 miles. *Services*, w. i. and cement. Pipe and specials furnished by Warren Foundry and Machine Co., Phillipsburg, N. J. Pipe laid by Chas. H. Eglee, Flushing, L. I. *Taps*, 375. *Meters*, 80. *Hydrants*, Ludlow, 78. *Gates*, Ludlow.

Consumption, 72,700 galls. *Pressure*: Ordinary, 45 to 60 lbs. Fire, 100 lbs.

Financial.—Cost, $79,330. Debt, $75,000. Int., 4%. Ann. op. exp., $2,200. Ann rev.: consumers, $4,121; city, $3,000. Hydrant rental, $1,500 allowed.

Management.—Three Commrs. Chairman, E. P. Le Baron. Actg. Supt. and Clerk, Jos. E. Beals.

MIDDLETON, *Essex Co.* (Pop., 1,000; est., 1,000.)

History.—Supplied since '76 from Danvers Water-Works. Has 62 taps and 4 hydrants. Is a part of the Danvers system, which see.

MILFORD and HOPEDALE, *Worcester Co.* (Pop.: Milton, 9,310; est., 10,000. Hopedale, est., 2,000.) Milford is on Charles river and is engaged in manufacturing machinery, boots and shoes, cotton and straw goods.

History.—Built in '82 by Milford Water Co. Engr., Moses Joy, Jr. Contr., Geo. B. Inman, New York City.

Water Supply.—Charles river for fire purposes and wells for domestic use, by direct pumping. Wells are each 30 ft. deep and 23, 19 and 14 ft. in diam., respectively.

Pumping Machinery.—Holly boiler and pump, also Knowles pump; combined dy. cap., 2,000,000 galls.

Buildings.—Contr., Milford Patties.

Distribution.—*Mains*, c. i., 19 miles. *Services*, lead. Pipe furnished by; McNeal Pipe & Foundry Co., Burlington, N. J.; Warren Foundry & Machine Co., Phillipsburg, N. J.; R. D. Wood & Co., Philadelphia, Pa.; Donaldson Iron Co., Emaus, Pa.; Gloucester Iron Works, office, 6 North Seventh St., Philadelphia, Pa. *Taps*, 900. *Meters*, 43. *Hydrants*, Chapman, Ludlow and Mathews, 88. *Valves*, kind, do.

Consumption, 300,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $270,000. Capital stock, $150,000. Bonded debt, $100,000. Int., 5 and 5½ %. Ann. op. exp., $3,200. Ann. rev.; consumers, $15,000; city, $3,787. Hydrant rental, $46.66 for first 60, $30 for each additional.

Management.—Prest., C. W. Shippee. Treas., J. P. Daniels. Secy., F. J. Dutcher. Supt., Wm. H. Barney.

NAHANT, *Essex Co.* (Pop., 808; est., winter, 700; summer, 800.) On a rocky peninsula on the Atlantic coast, chiefly a summer resort.

History.—Supplied in '85 by Marblehead Water Co. A temporary supply was obtained from driven wells after '81, and a distribution system put in. Engr., E. W. Bowditch, Boston.

Water Supply.—From Marblehead Water Co.'s system, through a meter.

Distribution.—*Mains*, c. i., 7¼ miles. *Services*, w. i. *Taps*, 140. *Meters*, 5. *Hydrants*, Wood's, 25. *Valves*, Chapman.

Consumption, 30,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 90 lbs.

Financial.—Cost, $53,000. Debt, none. No further data given.

Management.—Supt., R. L. Cochran.

NANTUCKET, *Nantucket Co.* (Pop., 3,727; est., 3,142.) On low island in Nantucket bay. Engaged in codfishing and coast trade. A summer resort. Settled over 200 years ago.

History.—Built in '78 by Wannaconnet Water Co. Engr., Moses Joy, Jr., Boston.

Water Supply.—Wannaconnet pond, by direct pumping, and pumping to tank. Pond has an area of 8 acres, drainage area of 25 acres, is two miles from the town, between low hills, is 18 ft. deep in the middle and its surface is 6 ft. above sea-level.

Pumping Machinery.—Duplex Blake pump with 8-in. steam and 6-in. water cylinders of 10 in. stroke was erected in '78, and a duplex Worthington pump with 18½-in. steam and 14¼-in. water cylinders of 10-in. stroke erected in '80; combined dy. cap., 1,500,000 galls.

Tank.—Cap., 50,000 galls.; is 24 ft. in diam. by 15 ft. high, and is on a hill upon columns, thus giving its top an elevation of 100 ft. above sea-level.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead and galv. i. *Taps*, 468. *Meters*, none. *Hydrants*, Ludlow, 32. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Capital stock, $30,000. Bonded debt, $20,000. Int., 6%. Ann. rev.: consumers, $5,200; city, $824. Hydrant rental, $26.66 for first 30 and $12 for each additional. No further financial data given.

Management.—Prest., R. Gardner Chaser. Secy., Treas. and Supt., Wm. F. Codd.

NATICK, *Middlesex Co.* (Pop., 3,479; est., 8,500.) On Charles river, 17 miles from Boston. Engaged in manufacturing boots, shoes, base-balls, baby-carriages, wooden-ware and clothing. Incorp. in 1781.

History.—Built in '74 by city. Engr., M. M. Tidd, Boston. Contrs., Geo. H. Norman, Newport, R. I., and C. L. Goodhue, Springfield.

Water Supply.—Dug pond, by direct pumping and pumping to reservoir.

Pumping Machinery.—Worthington duplex pump. dy. cap., 1,500,000 galls.

Reservoir.—Cap., 3,500,000 galls.; in excavation and embankment, 175 ft. above pump, and connected with it by 12,000 ft. of 12-in. pipe.

Distribution.—*Mains*, w. i. and cement, 27 miles. *Services*, galv. i. *Taps*, 1,230. *Meters*, 41. *Hydrants*, Pattee & Draper, 112. *Valves*, kind, do.

Consumption, 265,000 galls. *Pressure*: Ordinary, 60 to 90 lbs. Fire, 60 to 90 lbs.

Financial.—Cost, $220,000. Debt, $118,400. Int., 4 %. Ann. op. exp., $4,380. Ann. rev.: consumers, $15,520; city, none. Hydrant rental, free.

Management.—Three Commrs.: Prest., P. Bigelow. Secy., G. W. Ingall, and R. Ellis. Supt., J. W. Morse.

NEW BEDFORD, *Essex Co.* (Pop., 26,845; est., 36,000.) On Acushnet river and Buzzard's bay, most of the city lying on a hillside which ascends gradually from tide-water to 100 ft. elevation. The western slope of the city descends into Tripp's brook valley. Largely engaged in whale fishery and manufacturing cotton. Settled in 1650; incorp. a town in 1787, a city in '47.

History.—Built in '65-9 by city when population was about 23,000. Chf. Engr., Geo. A. Briggs. Consulting Engr., Wm. J. McAlpine, New Brighton, N. Y.

Water Supply.—Acushnet river, by gravity from a storage reservoir to the city, thence by pumping to a distributing reservoir and stand-pipe. The storage reservoir is about 7 miles from center of city, and the river above has a water-shed of 5 sq. m.

Storage Reservoir.—Has an area of 400 acres, a cap. of 400,000,000 galls., and is 40 ft. above tide-level.

Dam.—The first dam was of earth, 600 ft. long, 25 ft. high, 20 ft. wide on top, with slopes of 2 to 1. It was built in a swamp, with muck from 2 to 12 ft. deep, beneath which was from 1 to 3 ft. of hard pan, overlying 20 to 30 ft. of fine sand, beneath which was rock. A puddle wall was carried to and sometimes below hard-pan, and all the muck was removed from under the upper slope of the dam, while the lower slope was faced with a dry stone wall.

From the gate-house on the upper slope a waste culvert and conduit extended through the dam, being founded upon sand. In '67, after filling the reservoir, leaks began to appear, and in Feb., '68, the gate-house and 100 ft. of the bank were swept away. W. J. McAlpine reported that the failure was due to the fine sand beneath the gate-house and culvert becoming saturated and running as quicksand. In rebuilding, this material was confined by two rows of sheet piling, 15 ft. apart. The inner slope of the dam is now protected by a lining of large stone, and there is a 50-ft. waste-way of rubble hydraulic masonry, resting upon a timber and plank platform, placed upon a puddled earth foundation, and having an overfall of hammer-dressed stone. The gate-house also rests upon a timber and plank foundation, and is of hammer-dressed stone laid in hydraulic cement.

Conduit.—Single ring, brick, oviform, 3 by 4 ft., having 3-ft. semicircular bottom, and extending 5⅝ miles with a grade of 0.58 ft. per mile, and with three overflows.

Receiving Reservoir.—The conduit discharges into a 3,000,000 gall. receiving reservoir at an elevation of 30 ft. above tide. The reservoir is 12 ft. deep, has banks 12 ft. wide on top, slopes 2 to 1 outside, and 1½ to 1 inside. The inner slope is lined with puddle 4 ft. wide at top and 10 ft. wide at bottom, carried 3 ft. below bottom, and protected with a lining of 1 ft. granite stones having joints well filled with gravel.

Pump Well.—Connected with receiving reservoir by a 269-ft. stone culvert, and is 12 by 31 ft., by 17 ft. deep, with four 5 by 6 ft. recesses for pumps.

Pumping Machinery.—Combined dy. cap., 15,000,000 galls.; McAlpine of 6,000,000 galls. cap., built by Quintard Iron Works, New York City; one Worthington of 4,000,000 galls. cap., and one of 5,000,000 galls.

Distributing Reservoir.—Cap., 16,000 galls. Is 124 ft. above, and 2,200 ft. from, pump-well, and 154 ft. above tide-level. Its depth is 17 ft., its embankments from 8 to 18 ft. above natural surface of ground, with tops 15 ft. wide and slopes of 2 to 1. The inner slope is lined with puddle 7 ft. wide at top and 15 ft. wide at bottom of reservoir, and carried 5 ft. below. This puddle is covered with 12 ins. of gravel on which is laid a granite wall 8 ins. thick at bottom and 12 ins. at top.

Stand-Pipe.—For use in esmergency, 5 ft. in diam. and 62 ft. high.

Distribution.—*Mains*, c. i., w. i. and cement, 54.37 miles. *Services*, c. i. and lead. *Taps*, 5,495. *Meters*, Crown, Equitable, and Balls & Fitts rotary, 102. *Hydrants*, Chapman and Coffin for past 10 years, 410. *Valves*, kind, do.

Consumption, 3,047,404 galls. *Pressure*: Ordinary, 33 lbs. Fire, 33 lbs.

Financial.—Cost, $1,298,461. Debt, $790,000. Int., av., 5.81%. Ann. op. exp., $26,208. Ann. rev.: consumers, $45,880; city, $89,800, of which $12,000 is a general appropriation for water and the remainder for debt.

Management.—Water Board. Clerk, Supt. and Chf. Engr., Robt. C. P. Coggeshall. Registrar, Jas. H. Hathaway. Pumping Engr., A. S. Negus.

NEWBURYPORT, *Essex Co.* (Pop., 15,538; est., 14,000.) On Merrimac river, a port of entry, and has large commercial and manufacturing interests, producing brushes, hats, shoes, silverware and cotton goods.

History.—Built in '81 by Newburyport Water Co. Engr. and Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Spring, pumping to tank.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two upright, compound, double-acting pumps, made by A. Russell & Sons, Newburyport.

Tank.—Cap., 300,000 galls.; is 40 ft. in diam., and 35 ft. high, and about 16.5 ft. above tide-level.

Distribution.—*Mains*, c. i., w. i. and cement, 26 miles. *Services*, w. i. and cement. *Taps*, 1,360. *Meters*, 20. *Hydrants*, Chapman and Holyoke, 165.

Consumption, 375,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Capital stock, $300,000. No bonded debt. Hydrant rental, $40. No further financial data given.

Management.—Prest., H. B. Little. Treas., Geo. H. Norman. Supt., J. E. McCusker.

NEWTON, *Middlesex Co.* (Pop., 16,995; est., 22,500.) On Charles river, about 7 miles from Boston. Engaged in paper and other manufacturing.

History.—Built in '76 by city. Des. Engrs., Moses Lowe and Frederic Schaff. Const. Engr., Edw. Sawyer.

Water Supply.—Charles river, by pumping to reservoir from filter basin.

Filter Basin.—Across river from Newton, following the river in the shape of a bow. In gravel, 1,575 ft. long, and from 70 to 88 ft. wide, with 10-ft. embankments along its sides for protection. In '80, under advice of Wm. E. Worthen, several pipes were driven through the sand bottom of the filter basin to coarse gravel, 35 ft. below, resulting in a daily yield of 400,000 galls. of water.

Conduit.—A 24-in. outlet pipe crosses the river, and connects the filter basin with the pump-well.

Pump-Well.—Brick walls with a bottom of Georgia pine, 9.83 by 29.75 ft., and 15 ft. deep.

Pumping Machinery.—Horizontal boiler made by Kendall & Roberts, Cambridgeport. Worthington pumps, combined dy. cap., 6,000,000 galls.; one 1,000,000-gall. duplex high-pressure, with 12-in. water plungers and 15-in stroke, and one 5,000,000-gall. compound duplex, with 22-in. water plungers and 50-in. stroke.

Reservoir—Cap., 15,000,000 gall.: storage and regulating, is pentagonal, in two divisions, built in excavation and embankment on Waban hill with water surface 295 ft. above low-tide. Has puddle wall in center and a 2-ft. puddle lining over slopes of banks, under the banks and on reservoir bottom. The slopes are covered with 6 in. of small stones and 15-in. stone pavement above.

Distribution.—*Mains*, c. i., 83.2 miles. *Services*, lead, enam. i. *Taps*, 3,768. *Meters*, 2,370; principally Crown, with some Worthington and Union and a few Desper and Spooner. *Hydrants*, Whittier Machine Co.'s improved, 540. *Valves*, Chapman.

Consumption, 203,702 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $1,119,544. Debt, $1,115,000. Int., 4, 5 and 6%. Ann. op. exp., $13,867. Ann. rev.: consumers, $48,142: city, $14,301. Hydrant rental, $20.

Management.—Five Commrs. Prest., Edw. W. Cate. Registrar and Clerk, Albert S. Glover. Engr. of Board, Alfred F. Noyes. Supt., F. Nelson Hyde, Jr. Inspector of Meters and Fixtures, J. Clifton Whitney.

NORTH ADAMS, *Berkshire Co.* (Pop., 10,191; est., 15,000. On Hoosac river, in hilly country. Manufactures cotton and woolen goods and shoes.

History.—Built in '65 by fire district. Const. Engr., Frank B. Locke, now at Salmon City, Ida.

Water Supply.—Brook and two artesian wells: by gravity from brook and by pumping from wells, the latter yielding 800,000 galls. daily.

Reservoirs.—Collecting, settling and distributing: cap., 100,000, 10,000,000 and 750,000 galls., respectively. The latter is 250 ft. above town.

Pumping Machinery.—Knowles, dy cap., 2,400,000 galls.

Distribution.—*Mains*, c. i., 40 miles. *Services*, w. i. *Taps*, 1,800. *Meters*, 10. *Hydrants*, kind not given, 126.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 87 lbs. Fire, 87 lbs.

Financial.—Debt, $200,000. Int., 4%. Ann. op. exp., not given. Ann. rev.: $20,547.

Management.—Prudential Comm. Chairman, A. W. Preston. Supt., Jno. J. Marsh. Report made by A. W. Locke.

NORTHAMPTON, *Hampshire Co.* (Pop., 12,172; est., 14,000.) On Connecticut river, the main portion being on elevated ground one mile from river. Engaged in manufacturing.

History.—Built in '71 by city, and supplies villages of Florence and Leeds, which are on the pipe line. Engrs., Nelson J. Welton and Wm. W. Bonnett, Waterbury, Conn.

Water Supply.—Roberts Meadow brook, by gravity from impounding reservoirs. Brook flows through rough granite region.

Reservoirs.—One 4,000,000 galls, and one 16,500,000 galls.

Dam.—At first reservoir: earth, 17 ft. high at centre with heart-wall of puddle 12 ft. wide at bottom and 6 ft. at top, with upper slope of 2 to 1 paved with stone. The flow line is 240 ft. above town.

Gate Chamber.—Brick, from which a 24-in. waste and 46-in. supply pipe pass through dam.

Distribution.—*Mains*, c. i., 32½ miles. *Services*, c. i., enam. i., galv. i. *Taps*, 2,032. *Meters*, 9. *Hydrants*, Mathews and Holyoke, 172. *Gates*, Ludlow and Chapman, 133.

Consumption, 150,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $255,907. Debt, $170,000. Int., 3½, 4 and 6%. Ann. op. exp., $2,592. Ann. rev.: consumers, $21,642; city, $4,000.

Management.—Six Commrs. Prest., D. W. Bond. Treas., O. Edwards. Clerk. H. A. Kimball. Supt., J. M. Clark.

NORTH ATTLEBOROUGH, *Bristol Co.* (Pop., est., 7,000.)

History.—Built in '84 by fire district. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Well, 30 ft. deep and 26 ft. in diam., by pumping to tank. Contrs. for well, Collins & Morley, Boston.

Pumping Station.—Brick, with granite trimmings. Contr., Abram T. Briggs, Taunton.

Pumping Machinery.—Davidson compound condensing pump, dy. cap., 1,000,000 galls.

Tank.—Built by Cunningham Iron Works, Boston: 40 ft. in diam. and 60 ft. high.

Distribution.—*Mains*, c. i., 11 miles. *Services*, enam. i. *Taps*, 471. *Meters*, Crown and Union rotary, 200. *Hydrants*, Mathews and Ludlow., 101. *Valves*, kind, do.

Consumption, 120,000 galls. *Pressure*: Ordinary, 82 lbs. Fire, 82 lbs.

Financial.—Cost, $125,000. Bonded debt, $125,000. Int., 4%. Sinking fund, $13,442. Ann. op. exp., $3,500. Ann. rev.: consumers, $3,710.

Management.—Commrs.: Chairman, D. S. Hall. Clerk, Supt. and Engr., Walter P. Whittemore.

NORTHBOROUGH, *Worcester Co.* (Pop., 1 676; est., 2,000.) On Assabet river, on nearly level ground, surrounded by hills. Engaged in manufacturing shell jewelry and woolen cloth.

History.—Built in '82 by town. Engr., Percy M. Blake. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—West branch of Cold Harbor brook, by gravity from impounding reservoir. Brook is 3 miles from, and 180 ft. above, village.

Reservoir.—Of 12 acres area, a drainage area of 2¼ sq. m. and cap. of 30,000,000 galls.

Dam.—Forms reservoir, is 650 ft. long, 20 ft. high, and has a heart-wall of rubble masonry laid in cement.

Distribution.—*Mains*, w. i. and cement, 8.5 miles. *Services*, enam. i. *Taps*, 208. *Meters*, none. *Hydrants*, Chapman, 51.

Consumption, 70,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $66,992. Debt, $61,500. Int., 4 %. Ann. op. exp., $350. Ann. rev: consumers, $3,439.

Management.—Three Commrs. Prest., G. P. Heath. Secy., S. Small. Supt., R. R. Yates.

NORTH GRAFTON, *Worcester Co.* See Grafton and North Grafton.

NORWOOD, *Norfolk Co.* (Pop., 2,345; est., 4,000.) Manufacturing town 15 miles from Boston.

History.—Built in '85-6 by town. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Pond, pumping to reservoir. Pond is fed by springs and has area of 29 acres.

Pumping Machinery.—Davidson pump, dy. cap., 1,000,000 galls.

Reservoir.—Cap., 15,000,000 galls. Contrs., Mitchell & Harris, Boston.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. Pipes furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and laid by Jno. T. Langford, Newton. *Taps*, 340. *Meters*, 70. *Hydrants*, Chapman, 76. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 59 lbs.

Financial.—Cost, $105,000. Debt, $100,000. Int., 4%. Ann. op. exp., $2,500. Ann. rev.: consumers, $4,500. Hydrant rental, free.

Management.—Clerk, Chas. T. Wheelock. Supt., Geo. A. P. Buckram.

PALMER, *Hampden Co.* (Pop. supplied, est., 2,000.) On Chicopee river. Manufactures carriages, straw hats and cotton goods.

History.—Built in '86 by Palmer Water Co. Engr., C. L. Goodhue, Springfield. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Numerous springs, by gravity from storage to distributing reservoir, thence by gravity to village. Upper storage reservoir has area of 5 acres and lower distributing reservoir of 1 acre.

Distribution.—*Mains*, w. i. and cement, 5 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, Chapman, 40. *Valves*, Chapman.

Consumption, 75,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $40,000. Debt, $20,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,500; city, $800. Hydrant rental, $40.

Management.—Prest., C. L. Goodhue, Springfield. Treas. and Supt., Jno. H. Gamwell.

PEABODY, *Essex Co.* (Pop. 9,028; est. 10,000.) About 2 miles from Boston, on irregular ground rising from tide-water to an elevation of 160 ft. Engaged in tanning, and morocco manufacturing.

History.—First supplied in 1799 by Salem & Danvers Aqueduct Co., which had a capital of $10,000. The supply was by gravity from springs collected in a reservoir, through 3-in. bored pine logs, which were changed to 5-in. in '04 and to iron pipes in '34. In '59 the company had expended $246,200, had laid 40 miles of pipe and had 3,400 takers. Separate works were built by Salem in '88, by Danvers in '76, while in '73 Peabody bought the old system for $125,000, which then consisted of Spring pond with an area of 59 acres at 60 ft. above tide-level, Brown's pond, and two stone reservoirs, 100 by 300 ft. and 5 ft. deep.

In '81-2 high service works were built by the town, Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Surface water, by gravity and by pumping to tank.

Pumping Machinery.—Worthington pump, dy. cap., 2,000,000 galls.

Tank.—Made by Cunningham Iron Works, Boston, wrought iron, 60 ft. in diam. and 25 ft. high.

Distribution.—*Mains*, c. i., w. i. and cement. *Services*, w. i. and cement. *Taps*, 1,500. *Meters*, 1. *Hydrants*, Post, 163.

Consumption, 617,114 galls. *Pressure*: Ordinary, 95 lbs. Fire, 65 lbs.

Financial.—Cost, $287,135. Debt, $223,000. Int., 4%. Ann. op. exp., $6,602. Ann. rev.: consumers, $23,845.

Management.—Water Board; Chairman, D. S. Littiefield; Clerk, Jas. Rodie; Supt., M. N. Quint.

PITTSFIELD, *Berkshire Co.* (Pop., 13,364; est., 14,000.) In an elevated valley. Engaged in manufacturing and general trade. Incorp. a town in 1761.

History.—Built in '55 by town. Engr., Phineas Ball, Worcester.

Water Supply.—Ashley Lake, having an area of 80 acres, and Sackett brook, by gravity to three distributing reservoirs.

Reservoir.—Three; cap., 200,000 galls. each. Two of these have an elevation of 128 and 140 ft., respectively, above town, and are built of earth and stone.

Distribution.—*Mains*, c. i., 36 miles. *Services*, all kinds, each party putting in its own. *Taps*, 2,200. *Meters*, 8. *Hydrants*, Mathews, 83. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $239,541. Debt, $190,000. Int., 4 to 6%. Ann. op. exp., $3,786. Ann. rev.: consumers, $22,573; city, $2,080.

Management.—Commrs., Chairman, W. R. Plunkett. Supt. J. M. Hatch.

PLYMOUTH, *Plymouth Co.* (Pop. 7,093; est., 7,500.) On Plymouth harbor in Massachusetts bay, on uneven land with sand and gravel soil.

History.—Built in '55 by town. Engr., Moses Bates. Consulting Engr., Wm. S. Whitwell.

Water Supply.—Great and Little South ponds, by gravity and direct pumping. The first two ponds have sandy shores and a drainage area of 600 acres, mostly covered with oak and pine.

Reservoirs.—Cap., one of 1,600,000 galls. and another 1,370,000 galls. The first is in excavation and embankment with inner slopes lined with 18 in. of clay puddle, upon which is gravel and a stone pavement. The second was built in '87, and is lined with 5 in. of concrete, composed of 1 part cement, 2 sharp sand and 6 parts gravel, this being covered with ¾ in. of cement and sand, 1 to 1.

Pumping Machinery.—Worthington compound duplex pump; dy. cap., 1,440,000 galls.

Distribution.—*Mains*, w. i. and cement, 27.3 miles. *Services*, w. i. and cement, lead and galv. i. *Taps*, 1,317. *Meters*, 1. *Hydrants*, Chapman, 72. *Valves*, Chapman.

Consumption, 588,519 galls. *Pressure*: Ordinary, 36 lbs. Fire, 45 lbs.

Financial.—Cost, $230,153. Debt, $141,000. Int., 4 to 6%. Ann. op. exp., $4,615. Ann. rev.: consumers, $14,983; city, none.

Management.—Five Commrs. Supt. R. W. Bagnell.

QUINCY, *Norfolk Co.* (Pop., 10,570; est., 13,000.) On Massachusetts bay, surrounded by high granite hills. Engaged in quarrying granite and manufacturing shoes. Settled in 1640; incorp. a town in 1792.

History.—Built by Quincy Water Co. in '84. Engrs., A. H. Howland, Boston, and Phineas Ball, Worcester.

Water Supply.—Ground and surface water from wells and stream, by pumping to stand-pipe. A well 30 ft. in diam. by 28 ft. deep is sunk in a gravel bed. An additional supply is obtained by leading Town brook, with a minimum daily yield of 400,000 galls., through a filter bed and connecting it with the well.

Filter Bed.—Screened gravel, in which are 16 rows of 6-in. drain pipe, 250 ft. long, with lap of each joint cemented and bottom open. The pipes have 10 in. of gravel about them, the surface-level of which is 42 in. below water-level of brook. The discharge into the well is controlled by gates.

Pumping Machinery.—Two Deane pumps, dy. cap. of each, 2,000,000 galls. One is a high-pressure duplex of 24-in. steam, and 14-in. water cylinder and 18-in. stroke; the other, a compound, condensing duplex, of 16 and 30-in steam, and 44-in. water cylinder, and 24-in. stroke.

Stand Pipe.—Cap., 318,000 galls. Made by Cunningham Iron Works, Boston; 30 ft. in diam. and 60 ft. high.

Distribution.—*Mains*, c. i., kal. w. i., 24.5 miles. *Services*, w. i., lead, galv. i. *Taps*, 850. *Meters*, 25. *Hydrants*, kind not given, 98.

Consumption, 250,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $275,000. Debt, $125,000. Int., now 6%, being refunded at 5%. Ann. rev.: city, $3,650. Hydrant rental, $35. No further financial data given.

Management.—Prest., E. H. Porter. Treas., W. L. Faxon. Supt., F. E. Hall.

RANDOLPH, *Norfolk Co.* (Pop. 4,027; est. 5,000) Is 15 miles south of Boston. Manufactures boots and shoes.

History.—Built in '87-8 by towns of Randolph and Holbrook, the towns owning jointly the pumping station and stand pipe, and mains between. Engr., M. M. Tidd, Boston. Contr. for buildings and masonry, H. Pike & Son, Cambridge.

Water Supply.—Lake in Randolph and Braintree, by pumping to stand-pipe.

Pumping Machinery.—Holly, dy. cap., 2,000,000.

Stand Pipe.—Made by Cunningham Iron Works, Boston; 30 ft. in diam. by 125 ft. high.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. and cement. Pipe and specials furnished by Warren Foundry & Machine Co., Philipsburg, N. J. Pipe laid by J. T. Langford, Boston. *Taps*, 200, *Meters*, not given. *Hydrants*, Chapman, 90. *Valves*, Chapman.

Consumption, 100,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $100,000. Stock and bonds, $125,000. Int., 4%. Ann. op. exp., $3,000 Ann. rev.: city, $3,500. Hydrant rental, $35.

Management.—Jointly by the two towns of Randolph and Holbrook. Prest. of Board, J. White Belcher. Supt., E J. Chadbourne.

REVERE and WINTHROP, *Suffolk Co.* (Pop.: Revere, 2,263; est., 4,000. Winthrop, 1,043: est., 1,500.) Suburbs of Boston.

History.—Built in '84 by Revere Water Co.

Water Supply.—Driven wells, by pumping to reservoir.

Reservoir.—Cap., 1,500,000 galls.

Pumping Machinery.—Knowles and Deane pumps, dy. cap., each, 1,250,000 galls.

Distribution.—*Mains*, w. i. and cement, 32 miles. *Services*, w. i. and cement. *Taps*, 1,400. *Meters*, not given. *Hydrants*, Chapman, Ludlow, Holyoke, 110. *Valves*, kind, do.

Consumption, 350,000 galls. *Pressure*: Ordinary, 75 lbs. Fire 75 lbs.

Financial.—Hydrant rental, $50. All other financial data withheld.

Management.—Prest., Wm. Birnie. Treas., T. N. Birnie. Supt., Albert D. Burnham.

RICHMOND FURNACE, *Berkshire Co.* (Pop., est., 400.) On both sides Center brook, on irregular ground.

History.—Built in '82 by Richmond Iron Works to supply their shops and houses. Engr., Wm. E. Pattee.

Water Supply.—Center brook, by gravity. A stone masonry dam, 100 ft. long by 8 ft. high, forms a reservoir of ½ acre, 4,000 ft. from village. The water passes through a charcoal filter at the dam.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i. *Hydrants*, 3.

Financial.—Cost, $4,000.

Management.—By above company. H. J. Dresser.

RIVERSIDE, *Franklin Co.* (Pop., not given.)

History.—A private company has constructed works at a cost of $8,000. A charter has been granted to the Riverside Aqueduct Co., who propose to assume the present works, but they had not organized under the provisions of their charter the latter part of May. Attempts to obtain further data regarding the old or new works have been unsuccessful, but if secured later they will be found in supplement. The facts already obtained were given by T. M. Stoughton, Riverside, one of the incorporators of the Riverside Aqueduct Co.

ROCKLAND, *Plymouth Co.* (Pop., 4,553; est, 5,000.) Manufactures boots, shoes and tacks.

History.—Built in '86 by town. The pumping machinery, stand-pipe and 6 miles of mains are owned jointly with the adjoining town of Abington, and the works were constructed and are managed by a joint commission from the two towns. Des. Engr., S. C. Heald, Worcester. Const. Engr., J. J. Walkenburg, Worcester.

For details regarding water supply, pumping machinery, stand pipe and contractors see Abington.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i. and cement. *Taps*, 600. *Meters*, 50. *Hydrants*, Coffin, 100. *Valves*, Coffin.

Consumption, 115,000 galls. *Pressure*: not given.

Financial.—Bonded debt, $123,000. Int., 4%. Ann. rev.: consumers, $5,000; city, $1,800.

Management.—Commrs. Chairman, G. W. Kelley. Secy., Geo. Hunt. Supt., W. R. Rose.

SALEM, *Essex Co.* (Pop., 27,563; est., 28,000.) On low land projecting into the sea, and has a fine harbor.

History.—Present system built by city '65-9, and furnishes water to Beverly. Des. Engr., Jas. Slade. Const. Engr., Chas. H. Swan. Consulting Engr., after Feb., '68, Jas. P. Kirkwood.

The first supply was furnished by Dan'l Frye, in 1796, when the population was about 8,000, and was from a well on Gallows hill, through wooden pipes. In '07 five persons styling themselves "The Proprietors of the Frye Aqueduct" took water from this well and the company continued till '52. The Salem & Danvers Aqueduct Co. (see Peabody) built works in 1799, and extended and operated them until '73, when they were sold to Peabody.

Water Supply.—Wenham lake, by direct pumping, and by pumping to reservoir. The lake has an area of 320 acres, a depth of 53 ft. and a drainage area of 2.7 sq. m. It is fed by springs, has a smooth, gravelly margin and a bottom free from mud, vegetation, or quartzose sand.

Conduit to Pump-Well.—A 36 in. cast-iron pipe, with bell mouth turned up and grated, begins 32 ft. from shore, and conducts water 175 ft. to a masonry gate-chamber, 8 by 10 ft., from which a brick conduit 7 by 10 ft. and 26 ft. long leads to the pump-well.

Pump-Well.—Is 10 by 31¾ ft., inside of stone masonry, lined with 12 in. of brick, and resting on timber and plank platform covered with 2 ft. of concrete.

Pumping Machinery.—Two Worthington pumps, dy. cap., 5,000 galls. each, lift water 14 ft. through 5,600 ft. of mains.

Reservoir.—Cap., 20,000,000 galls.; in excavation and embankment, 400 ft. sq., 20 ft. deep, with surface 142 ft. above mean tide. In centre of banks is puddle wall, stepped down the slopes and carried 2 ft. thick over bottom, where it is covered with 1 ft. of gravel and a stone paving. The inner slopes are covered with 1 ft. of gravel and have a 15-in. dry stone wall.

Distribution.—*Mains*, c. i., w. i. and cement, 50 miles. *Services*, galv. i. *Taps*, 5,016. *Meters*, 138. *Hydrants*, Lowry, 352. *Valves*, Whittier Machine Co.

Consumption, 2,579,605 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $1,423,783. Debt, $542,860. Int., 5 and 6%. Ann. op. exp., $25,195. Ann. rev.: consumers, $50,943.

Management.—Wenham Water Board. Prest., A. H. Smith. Clerk, Nath. M. Brown. Inspector, A. A. Smith. Supt., B. S. Grush.

SHARON, *Norfolk Co.* (Pop., 1,492: est., 1,400.) Manufactures cutlery and carriages, and is a summer resort for invalids.

History.—Built in '85 by Sharon Water Co. Des. Engr., Percy M. Blake, Hyde Park. Const. Engr., A. H. Howland, Boston. Contr., W. C. McClallan, Boston.

Water Supply.—Spring, near Beaver brook, by pumping to tank.

Pumping Machinery.—Upright, tubular boiler, built by Cunningham Iron Works, Boston. Blake pump, dy. cap., 720,000 galls.

Tank.—Made by Cunningham Iron Works, Boston; 20 by 80 ft.

Distribution.—*Mains*, c. i., c. i. and cement, 4.5 miles. *Services*, lead. Pipe laid by T. F. Maney & Co., Boston. *Taps*, 110. *Meters*, 8. *Hydrants*, Chapman. *Valves*, Chapman.

Consumption, 20,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 50 lbs.

Financial.—Cost, $40,000. Capital stock, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers $1,600; city, $1,200 for hydrant rental and water for public buildings.

Management.—Prest., J. P. Farley, Jr., Boston. Treas., E. W. Bond, Springfield. Supt., W. B. Wicks.

SHELBURNE FALLS, *Franklin Co.* (Pop., 1,621.) Manufactures cutlery and hardware.

History—A system for domestic use was built in '84 by Covell Aqueduct Co. Const. Engr., G. G. Merrill.

Water Supply.—Mountain springs, by gravity.

Distribution.—*Mains*, w. i., 2.1 miles. *Services*, iron lead. *Taps*, 65. *Pressure*: 90 ft. head.

Financial.—Cost, $5,000. Debt, none. Ann op. exp., $20. Ann. rev.: consumers, $400.

Management.—Supt., L. T. Covell.

SAUGUS, *Essex Co.* (Pop., 2,625: est., 3,000.) On Saugus river, near Lynn. Engaged in manufacturing shoes and woolen goods. Settled in 1629: incorp. a town in '15.

History.—The village of East Saugus was supplied in '78 from Lynn and the rest of the town in '87. Town owns pipes. Const. Engrs., Chas. W. Gay of Lynn and Edw. A. Buss, Boston. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Lynn Water-Works, by connecting with same.

Distribution.—*Mains*, w. i. and cement, 9 miles. *Services*, w. i. and cement. *Taps*, 150. *Meters*, none. *Hydrants*, Chapman, 80. *Valves*, Chapman.

Consumption, 7,500 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $45,800. Debt, $40,800. Int., 4%. Lynn collects water-rates from Saugus and gives town a rebate of 37½%. Saugus pays Lynn hydrant rental of $28 for each 350 inhabitants.

Management.—Commrs.: Wilbur F. Newhall, Edw. Pranker and Chas. H. Bond.

SOMERVILLE, *Middlesex Co.* (Pop., 24,933: est., 36,000.) On Mystic river, 2 miles from Boston.

History.—Supplied in '68 from Mystic Water-Works, Charleston, now a part of the Boston system. All data included under Boston.

SOUTH ABINGTON, *Plymouth Co.* (Pop., 3,024; est., 4,000.)

History.—Built in '83 by town. Engr., S. C. Heald, Worcester. Contrs., Patent Water & Gas Pipe Co., Jersey City, N. J.

Water Supply.—Hobart pond, fed by springs, by pumping to stand pipe.

Pumping Machinery.—Boiler made by A. J. Russell & Son. Worthington pump, dy. cap., 1,250,000 galls.

Stand-Pipe.—Made by Cunningham Iron Works, Boston; 20 ft. in diam. and 103 ft. high.

Distribution.—*Mains*, w. i. and cement, 10 miles. *Services*, c. i., enam. i. Specials furnished by Davis & Farnum. *Taps*, 250. *Meters*, 130. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $73,000. Bonded debt, $68,000. Int., 4%. Ann. op. exp., $5,745. Ann. rev.: consumers, $4,129; city, $2,000. Hydrant rental, $25.

Management.—Three Commrs. Clerk and Supt., J. C. Gilbert.

SOUTHBRIDGE, *Worcester Co.* (Pop., 6,464; est., 7,000.) On Quinnebaug river. Engaged in manufacturing.

History.—Built in '81 by Southbridge Water Supply Co. Engrs., Buttrick & Wheeler.

Water Supply.—Springs and surface water, by gravity.

Reservoirs.—An earth dam 240 ft. long and 10 ft. high forms an impounding reservoir 200 ft. wide and 230 ft. long between two hills 100 ft. above the village. A second reservoir is to be constructed. Contr. for dam, Thos. Hennessy, Holden.

Distribution.—*Mains*, c. i., 1·7 miles. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Chapman.

Consumption, 25,000. *Pressure*: Ordinary, 62 lbs. Fire, 62 lbs.

Financial.—Cost, $25,000. Capital stock, $18,000. No debt. Ann. op. exp., $125. Ann. rev.: consumers, $1,700; city, $700. Hydrant rental, $30.

Management.—Prest. and Supt., F. L. Chapin. Treas., F. W. Eaton.

SOUTH FRAMINGHAM, *Middlesex Co.* (Pop., est., 5,500.) Manufactures boots, shoes, straw and rubber goods.

History.—Built in '85 by Framingham Water Co. Engr., A. H. Howland, Boston. Contr., Wm. C. McClallan, Boston.

Water Supply.—Farm pond and Sudbury river, by direct pumping.

Pumping Machinery.—Horizontal tubular boiler, made by R. F. Hawkins, Springfield. Two Deane pumps, one low and one high-pressure; combined dy. cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. Pipe laid by Lewis & Eglee, *now* C. H. Eglee, Flushing, N. Y. *Taps*, 425. *Meters*, 54. *Hydrants*, Coffin, 72. *Valves*, Coffin:

Consumption, 260,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $225,000. Capital stock, $125,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $10,355; city, $3,165.

Management.—Prest., Willis M. Ranney. Treas., Geo. E. Cutler. Secy., Sidney A. Phillips. Supt., A. E. Martin.

SOUTH HADLEY FALLS, *Hampshire Co.* (Pop., 2,750: est., 3,500.) On Connecticut river.

History.—Built in '72 by village. Des. Engr., W. B. Harris. Const. Engr., E. C. Davis.

Water Supply.—Buttery brook, by gravity from storage reservoir.

Reservoir.—Has area of about 1 acre and depth of 6 ft.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead, w. i. *Taps*, 265. *Meters*, none. *Hydrants*, Perkins, 60. *Valves*, Chapman.

Consumption, 150,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $60,000. Debt, $40,000, Int., 7 %. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,710; city, $2,000.

Management.—Commrs. Supt., M. F. Barnes.

SPENCER, *Worcester Co.* (Pop., 7,466; est., 9,000.) On Seven Mile river, on very broken ground. Manufactures boots, shoes, woolen cloth and wire. Settled in 1686: incorp. a town in 1753.

History.—Built in '83, ownership not given. Engr., S. C. Heald, Worcester. Contrs., Goodhue & Birnie, Springfield.

Water Supply.—Shaw's pond, by gravity. A small dam creates a pond of 67 acres, 200 ft. above, and 2½ miles from village, and with a drainage area of ¼ sq. m.

Distribution.—*Mains*, c. i., w. i. and cement, 12¾ miles. *Services*, w. i. and cement. *Taps*, 800. *Meters*, none. *Hydrants*, Holyoke, 88.

Consumption, unknown. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $240,079. Debt, $240,000, Int., 4 %. Ann. op. exp., $888. Ann. rev.: consumers, $19,334; city, $5,000. Hydrant rental, $50 for first 50, $40 for additional.

Management.—Supt., A. G. Pease.

SPRINGFIELD, *Hampden Co.* (Pop., 33,340; est., 40,000.) On east bank of Connecticut and Mill rivers, the western part being level and the eastern part on high ground rising gradually from the city. Has large and various manufactories. Settled in 1636; incorp. a city in '32.

History.—Present works were built in '73-5 by city. Engr., Phineas Ball, Worcester. The work was done by the city.

In '43, the population being 11,000, Chas. Stearns built a reservoir and laid 3 miles of 4, 6 and 7-in. bored wooden logs. In '45 these works were enlarged and the Springfield Aqueduct Co. organized; they built four reservoirs, known as the Lombard, Heywood, Chapin and Worthington. In '67 the wooden pipes were replaced by wrought iron and cement, and the east Van Horn reservoir constructed with an estimated capacity of 45,000,000 galls.: the Lombard reservoir was subsequently enlarged and the west Van Horn reservoir constructed. In '60 the city sunk a well and the City Aqueduct Co. was incorporated but soon dissolved.

Water Supply.—By gravity from impounding reservoirs in Ludlow and Belchertown.

Impounding Reservoir.—Area, 445 acres, with water surface 402 ft. above city datum. The reservoir is formed by two dams known as the Cherry Valley and Ludlow.

Cherry Valley Dam.—At outlet of tributary of Broad brook, on foundation of compact bluish hardpan, and built of the same material: with heart-wall of rubble masonry 18 in. thick, 1,297 ft. long coming within 2 ft. of surface of bank and protected from frost by dry rubble wall on each side, 18 in. thick and 2 ft. deep from top. The dam is 25 ft. wide on top, with slopes of 2 to 1: 39 ft. high above natural surface and 47.6 ft. above lowest point of excavation; 2,352 ft. long, 1,521 ft. varying in height from 3 to 5 ft. The 20-in. waste pipe is laid in stone masonry with a gate at each end. The masonry overfall rests on ledge rock. The inner slope is covered with rubble paving, 12 to 29 in. thick, the interstices filled with blue clay.

Ludlow Dam.—In ravine, on divide between drainage areas of Higher and Broad brooks; 496 ft. long with heart-wall of rubble masonry 333 ft. wide, with 6-in. concrete core. It is 35 ft. wide on top, 18 ft. high above natural surface, and 22 ft. above foundation.

Filters.—Above Ludlow dam, of wood "Excelsior" placed in boxes with vertical movement, which are raised and lowered by a derrick on bridge above.

Canals.—Water from the two brooks is conveyed to the reservoir by a 5,278-ft. canal with grade of 3.7 ft. to the mile, from Higher brook, and by a 11,960-ft. canal with only 1 ft. fall, from Broad brook.

Conduit.—To city from Ludlow dam, 56,410 ft. of 24-in. wrought iron, except 3,736 ft. of cast-iron. The Chicopee river is crossed by a 168 ft. bridge, the upper chords of which are two 26-in. tubes, 12 ft. apart, which form the conduit at this point, and are made of ⅜-in. riveted boiler plate, lined with cement after erection. The bridge was designed and built by Jno. R. Smith.

Distributing Reservoirs.—The high service is directly from the impounding reservoir, and the low service from the high, through a regulator valve, and also through Van Horn and Lombard reservoirs. The upper Van Horn reservoir has an area of 9.5 acres, a depth of 24 ft. and a capacity of 28,000,000 galls. The lower Van Horn reservoir has an area of 13.5 acres, is 30 ft. deep and has a capacity of 73,600,000 galls. The Lombard street reservoir has an area of 3 acres, is 23 ft. deep and has a capacity of 9,000,000 galls. All of the reservoirs have their water surface at 198.5 ft. above city datum.

Distribution.—*Mains*, c. i., w. i. and cement, 81½ miles. *Services*, w. i. *Taps*, 4,819. *Meters*, 472: mostly Crown, Union, Desper and Worthington, with a few Ball & Fitts, Undine and Whittier. *Hydrants*, Chapman, 528. *Valves*, Chapman.

Consumption, 4,000,000 galls. *Pressure*: 90 to 120 lbs.

Financial.—Cost, $1,335,535. Debt, $1,200,000. Int., 6 and 7%. Ann. op. exp., $25,148. Ann. rev.: consumers, $117,197; city, $14,892.

Management.—Three Commrs. Chairman, S. Q. Sanderson. Registrar, A. R. Hathaway. Supt., J. C. Hancock.

STATE ALMSHOUSE, *Tewksbury, Middlesex Co.* (Pop., not given.)

History.—Built in '79 by State.

Water Supply.—Surface water, by pumping to reservoirs and stand-pipe.

Pumping Machinery.—Worthington compound duplex and Blake No. 7 pump; combined dy. cap., 240,000 galls.

Reservoir.—Two. of 1,000,000 galls. each.

Stand Pipe—Is 30 by 40 ft.

Distribution.—*Mains*, c. i., 1 mile. *Services*, w. i. *Taps*, 2. *Meters*, none. *Hydrants*, 10.

Consumption, 75,000 galls. *Pressure*: 33 lbs.

Financial.—Cost, about $30,000. No debt. No further financial data given.

Management.—Trustees of Almshouse. Supt., C. I. Fisher.

STOCKBRIDGE, *Berkshire Co.* (Pop., 2,357; est., 2,100.) On Housatonic river, on uneven ground. Settled in 1718; incorp. in 1739.

History.—Built in '62 for domestic supply by Stockbridge Water Co.

Water Supply.—Springs and surface water and artesian wells, by gravity and pumping to reservoir. The former is from an impounding reservoir on Bear mountain.

Reservoirs.—The first reservoir was formed by building a stone and cement dam, 60 ft. long and 12 ft. high, across a ravine at the base of the mountain. The dam has a sand and gravel filter outlet. The second reservoir has a capacity of about 250,000 galls.

Pumping Machinery.—Knowles pump, dy. cap., 400,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, 1; others are owned by private parties, Holyoke, number not given.

Consumption and *Pressure*, not known.

Financial.—Cost, $18,500. Capital stock, $7,000. Bonded debt, $9,900. Int., 5%. Ann. op. exp., from $150 in wet year to from $600 to $800 in dry year. Ann. rev.: consumers, $1,600; city, none.

Management.—Prest., D. R. Williams. Secy. and Treas., D. A. Kimball. Supt., none.

STONEHAM, *Middlesex Co.* (Pop., 4,890; est. 6,000.) Manufactures shoes and leather. Settled in 1620; incorp. a town in 1725.

History.—Supplied in '83 by Wakefield Water Co. Has 750 taps, 17 meters and 50 hydrants. See Wakefield for all other data.

STOUGHTON, *Norfolk Co.* (Pop., 4,875; est., 5,173.) Manufactures boots and shoes.

History.—Built in '86 by Stoughton Water Co. Des. Engr., E. A. Hammett and L. A. Taylor. Const. Engr., M. Mason. Contrs. for masonry, N. C. Porter, Stoughton.

Water Supply.—Wells by pumping to tank.

Pumping Machinery.—Worthington pump, dy. cap., 65,000 galls.

Tank.—Made by E. Hodge & Co., Boston; 30 ft. in diam. by 60 ft. high.

Distribution.—*Mains*, iron, 4 miles. *Services*, lead, iron. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. Pipe laid by N. C. Porter, Stoughton. *Taps*, 100. *Meters*, 15. *Hydrants*, kind not given, 15. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Capital stock, $50,000. Bonds, $44,000. No further financial data given.

Management.—Prest., Wm. C. McClallan. Treas., E. W. Bond. Supt., Jno. W. Phinney.

SUNDERLAND, *Franklin Co.* (Pop., est., 300.)

History.—A system for domestic supply was built in '83 by Sunderland Water Co.

Water Supply.—Springs, by gravity to a small reservoir.

Distribution.—*Mains*, lead, 2 miles. *Services*, lead. *Taps*, 42.

Consumption, $12,000. *Pressure*: 80 ft. head.

Financial.—Cost, $2,100. Stock, $3,000. No debt. Ann. op. exp., slight. Ann. rev.: consumers, $202; city, $20.

Management.—Prest., Joel Burt. Treas., N. A. Smith. Supt., none.

SWAMPSCOTT, *Essex Co.* (Pop., 2,500; est., 2,500.) Engaged in fishing and is also a summer resort. Settled in 1625; incorp. a town in '52.

History.—Built in '53-4 by town, taking their supply from Lynn.

Water Supply.—Since '85 the supply has been from the Marblehead Water Co.'s plant. (See Marblehead.)

Distribution.—*Mains*, w. i. and cement, 5 miles. *Services*, not given. *Taps*, about 250. *Meters*, 3. *Hydrants*, Chapman and Holyoke, 65.

Consumption, 350,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $75,000. Capital stock, $75,000. Bonds, $75,000. No other financial data given.

Management.—Of Company: Prest. Thos. Appleton; Supt., Kendall Pollard.

TAPLEYVILLE, *Essex Co.* In town of Danvers, and its supply is a part of the Danvers system.

TAUNTON, *Bristol Co.* (Pop., 21,213; est., 25,000.) On Taunton river. Manufactures locomotives, machinery, cotton and woolen goods, stoves, rails, buttons, copper and silver ware. Incorp. a town in 1639, a city in '64.

History.—Built in '76 by city. Engr., Geo. H. Bishop.

Water Supply.—Ground water, with Taunton river for emergency, by direct pumping.

Filter Gallery.—Is 100 ft. from Taunton river at low water, is 400 ft. long; has slopes of 2 to 1, and is 17 ft. wide at depth of 8 ft. below mean low water mark. The slopes are paved with stone for 18 ft. from bottom and sodded above.

Pump-Well.—Is 28 ft. deep; connected with the filter by a 36-in. wrought iron pipe laid 4 ft. below the bottom of filter; also with the river by a 30-in. pipe ending in a plank crib 18 by 20 ft., inside of which is another 10 by 12 ft., the space between being filled with broken stone and there being 2 in. between each plank in the cribs.

Pumping Machinery.—A 3,000,000-gall. Holly quadruplex pumping engine; 14-in. steam cylinders, 9¾-in. pumps, all with 24-in. stroke. Also for fire-pressure, two Holly rotary pumps driven by a horizontal high-pressure engine; dy. cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 54.6 miles. *Services*, w. i. and cement. Pipes and specials furnished, and pipe laid, by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 2,892. *Meters*, 782. *Hydrants*, Chapman, Mathews, Ludlow, 470. *Valves*, kind do.

Consumption, 724,982 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $551,188. Bonded debt, $523,700. Int., 4 to 6%. Sinking fund, $181,133. Ann op. exp., $15,964. Ann. rev.: consumers, $38,414; city, appropriation for high service, $7,200.

Management.—Three Commrs. Clerk, Geo. F. Chase.

TURNER'S FALLS, *Franklin Co.* (Pop., est., 4,000.) On Connecticut river. Has several manufactories. Settled in '66; incorp. a fire district in '70.

History.—First supplied in '73 by a private company. Present works were built in '86 7 by fire district. Engr., Percy M. Blake, Hyde Park. Contr. for masonry and buildings, Jno. Lapoint, Turner's Falls. The first system was built after plans by Wm. P. Crocker, the supply being taken from springs and afterwards increased by pumping from river to reservoir. There were ten hydrants.

Water Supply.—Lake Pleasant, by pumping to reservoir.

Pumping Machinery.—Deane duplex compound condensing; dy. cap., 1,200,000 galls. *

Reservoir.—Cap. 1,300,000 galls.; at an elevation of 281.8 ft. above canal in village; circular, with inner slopes paved with granite blocks. Contr., Thomas Bros., Turner's Falls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. Pipe and specials furnished by Warren Foundry and Machine Co., Philipsburg, N. J. Pipe laid by Chas. H. Eglee, Flushing, N. Y. *Taps*, 215. *Meters*, none. *Hydrants*, Ludlow, 52. *Valves*, Peet.

Consumption, 225,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. Bonded debt, $100,000. Int., 4%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,000.

Management.—Three Commrs., Secy., H. D. Bardwell. Supt. none.

UXBRIDGE, *Worcester Co.* (Pop., 3,111; est., 3,000.) Has cotton and woolen and gun manufactories.

History.—Built in '80 by Uxbridge Water Co. Engr., A. W. Bennett. No general contractor.

Water Supply.—Springs, by gravity, through covered trenches to reservoirs.

Reservoir.—Covered; one 60 by 80 ft. by 10 ft. deep and one 28 ft. in diam. by 10 ft. deep; 137 ft. above and ⅛ mile from town.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 100. *Meters*, 12. *Hydrants*, Chapman, 25. *Valves*, Chapman.

Consumption, 2,000 galls. *Pressure*: Ordinary, 62 lbs. Fire, 62 lbs.

Financial.—Cost, $24,000. Debt, $20,000. Int., 5%. Ann. op. exp., $100. Ann. rev.: consumers, $1,500; city, $450. Hydrant rental, $15.

Management.—Prest. and Supt., A. W. Bennett. Treas., C. A. Taft.

VINEYARD HAVEN, *Dukes Co.* (Pop., est., 1,500.)

History.—Built in '87 by Vineyard Haven Water Co. Engr., O. G. Stanley, Vineyard Haven. Work done by company.

Water Supply.—Tashmoo springs, pumping to stand-pipe.

Pumping Machinery.—Blake, dy. cap., 1,000,000 galls.

Stand-Pipe.—Made by E. Hodge & Co., East Boston; 20 ft. in diam. and 50 ft. high.

Distribution.—*Mains*, c. i., 3.7 miles. *Services*, lead. Pipe furnished by Gloucester Iron Works, offices, Philadelphia, Pa., and Warren Foundry. Specials by Builder's Iron Foundry, Providence, R. I. *Taps*, 61. *Meters*, 4. *Hydrants*, Ludlow, 1.

Consumption, unknown. *Pressure*: Ordinary, 52 lbs. Fire, direct pumping, amount not given.

Financial.—Cost, $50,000. Debt, $20,000. Int., 6%. Ann. op. exp., $900. Ann. rev.: consumers, $1,200; city, none.

Management.—Prest., Chas. C. Jackson. Clerk., Wm. B. Owens. Supt., O. G. Stanley.

WAKEFIELD, *Middlesex Co.* (Pop., 5,547; est., 6,500.) On high ground. Manufactures iron castings, boots and shoes, rattan goods and pianos.

History.—Built in '83 by Wakefield Water Co. to supply Wakefield and Stoneham, jointly. Engr., Percy M. Blake, Hyde Park.

Water Supply.—Crystal lake, by pumping to stand-pipe. Area of lake, 60 acres.

Pumping Machinery.—Two Knowles duplex, cap., 1,000,000 galls. each.

Stand-Pipe.—Cap., 565,000 galls.; 40 ft. in diam., 62 ft. high, at an elevation of 200 ft. above pumps, 185 ft. above Wakefield and 125 ft. above Stoneham.

Distribution.—*Mains*, w. i. and cement, length not given. *Services*, c. i. *Taps*, 750. *Meters*, 5. *Hydrants*, kind not given, 80.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Hydrant rental, $50. No further financial data given.

Management.—Prest., David H. Darling. Treas., C. O. Burbank. Clerk, S. P. White. Supt., Geo. W. Harrington.

WALTHAM, *Middlesex Co.* (Pop., 11,712; est., 16,000.) On Charles river, 10 miles from Boston, on a level plain about 2½ m. sq., surrounded by high wooded hills. Has water power from river, and manufactures watches. Incorp. a town in '38.

History.—Built in '73 by town. Des. Engr., Edw. Sawyer. Const. Engr., Jos. H. Curtis.

Water Supply.—Surface water from filter basin near Charles river, by pumping to reservoir.

Filter Basin.—In gravel excavation, 8 ft. deep. A conduit 65 ft. long conveys the water to pump-well.

Pumping Machinery.—Cap., 3,000,000 galls. One 60 H. P. boiler made by Cunningham Iron Works, Boston, and one 111 H. P. Roberts boiler. Two Worthington compound pumping engines, with 14-in. high-pressure and 30-in. low-pressure steam and 14-in. water cylinders, all of 18 in. stroke.

Reservoir.—Cap., 6,000,000 galls.; in excavation and embankment, 230 by 280 ft., with semicircular ends; 165 ft. above pumps and 138 ft. above highest street level.

Distribution.—*Mains*, c. i., w. i. and cement, 35 miles. *Services*, w. i. and cement. *Taps*, 2,112. *Meters*, 25. *Hydrants*, old, Fales & Jenks, new, Chapman.

Consumption, 600,000 galls. *Pressure*: Ordinary, 56 lbs. Fire, 56 lbs.

Financial.—Cost, $388,000. Debt, $373,000. Int., 4 to 6%. Sinking fund, $25,610. Ann. op. exp., $26,702. Ann. rev.: consumers, $34,430; city, $4,350. Hydrant rental, $20.

Management.—Three Commrs. Supt., Geo. E. Winslow. Clerk, Leroy Brown. Pumping Engr., Chas. H. Whitehouse.

WARE, *Hampshire Co.* (Pop., 4,817; est., 6,300.) Manufactures cotton and woolen goods.

History.—Built in '86-7 by town. Engr., F. D. Fuller, Boston. Contrs. for pumping station, Aldrich & Hill, Ware.

Water Supply.—Collecting well, by pumping to reservoir. Contrs. for well, Keogh & Shaw, Providence, R. I.

Pumping Machinery.—Dy. cap. 1,500,000 galls. Boiler made by W. Allen & Sons. Deane pump, with 12 and 22-in. high and low-pressure cylinders, 12-in. plunger and 18-in. stroke.

Reservoir.—Is 149 by 154½ ft. at top, 82½ by 97½ ft. at bottom and 15 ft. deep from high water. Contr., F. A. Snow, Providence, R. I.

Distribution.—*Mains*, c. i., 7.4 miles. *Services*, w. i. and cement, 3.7 miles. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and McNeal Pipe & Foundry Co., Burlington, N. J. Pipe laid and hydrants set by Jno. T. Langford, Newton. *Taps*, 308. *Meters*, 41. *Hydrants*, Chapman, 52. *Valves*, Chapman.

Consumption, 90,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $81,048. Debt, $76,500. Int., 3½ and 4%. Ann. op. exp., $1,471. Ann. rev.: consumers, $3,029; city, $3,500.

Management.—Three Commrs. Supt., F. A. Volk.

WARREN, *Worcester Co.* (Pop., 3,889; est., 4,500.) Has steam pump works and cotton and woolen factories.

History and Water Supply.—The town owns pipes and 24 hydrants, and the Steam Pump Co., a steam pump. These are used for fire protection. Water is also pumped to an iron tank by water power and used by a few persons for sprinkling lawns. Water for these purposes is taken from the Quaboag river and Kinwam pond. A company bring water from springs by an aqueduct for domestic use. S. E. Blair is Town Clerk.

No other data can be obtained.

WATERTOWN, *Middlesex Co.* (Pop., 5,426; est., 7,000.) Is 8 miles from Boston. Has various manufactories.

History.—Built in '84 by Watertown Water Supply Co. Engr. Wm. Wheeler.

Water Supply.—Filter galleries near Charles river, by direct pumping and pumping to tank.

Pumping Machinery.—Deane pump, dy. cap., not given.

Tank.—Cap., 300,000 galls.; 40 ft. in diam. and 40 ft. high.

Distribution.—*Mains*, w. i. and cement, about 20 miles. *Services*, enam. i. *Taps*, (in '86) 600. *Meters*, not given. *Hydrants*, Ludlow, Chapman, Coffin, 174.

Consumption, $150,000 galls. *Pressure*: Ordinary, 90 lbs.

Financial.—Withheld.

Management.—Prest. A. O. Davidson. Supt., S. H. Perkins.

NOTE.—The above data was mostly furnished by W. T. Pierce.

WEBSTER, *Worcester Co.* (Pop. 5,696; est., 7,000.) Manufactures cotton, woolen and linen goods and shoes.

History.—Built in '68 by H. W. Slater, Jr., and run in connection with his woolen mill. Work done under supervision of Thos. K. Bates.

Water Supply.—Lake Chaubunagungamaug, by pumping to reservoir and direct pumping for fire pressure.

Pumping Machinery.—Cap., 432,000 galls.; Crocker's "twin rotary supply pump," No. 2., made by William Clark & Co., Pittsfield.

Reservoir.—Is 75 by 300 ft., and 8 ft. deep.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 185. *Meters*, 6. *Hydrants*, Chapman. *Valves*, Chapman.

Consumption, 180,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost, about $30,000. No debt. Ann. op. exp., cannot be separated from those of the mill. Ann. rev.: consumers, $2,000; city, $560. Hydrant rental, $500 for fire purposes, regardless of number.

Management.—By owner, H. W. Slater, Jr. Supt., Thos K. Bates.

WELLESLEY, *Norfolk Co.* (Pop., est., 3,000.)

History.—Built in '84 by town. Engr., F. L. Fuller, Boston. Contr. Jno. T. Langford, Newton.

Water Supply.—Filter basin, by direct pumping and pumping to reservoir.

Filter Basin.—Is about 400 ft. from Charles river, close to a brook leading from Longfellow's pond. It was made by excavating a pit, 12 ft. wide at the top, 11 at the bottom, 20 ft. deep and 63 ft. long, and lining the sides with a dry stone wall 5 ft. thick at bottom and 2½ at top. The water enters through the sides and bottom, and directly from the brook.

Pump-Well.—At north end of filter, 5 by 10 ft., of 20-in brick work and connected with the filter by a 20-in. gate. An 8-in. pipe, with gate, connects the pump-well with a spring 900 ft. distant.

Pumping Station.—Of brick and freestone, 34 by 61 ft., with an 80 ft. brick chimney. Contrs. W. E. Scribner, Newton.

Pumping Machinery.—A 1,000,000 gall. Blake compound condensing duplex pumping engine, with 12-in. high-pressure and 22-in. low-pressure steam cylinders, and a 10 in water plunger, all 18-in. stroke. There are two horizontal boilers made by Whittier Machine Co., Boston.

Reservoir.—Cap., 1,150,000 galls.: on Mangus hill, about 12,000 ft. from pumping station with which is connected by a 12-in main. Most of the houses supplied are along the main, so the pressure is practically direct. The reservoir is 133½ ft. sq. at top, and 73½ at bottom; its inner slopes are 2 to 1; the bank is 30 ft. wide on top and the outer slope is 1½ to 1. All the corners are rounded. The inner slopes are first covered with 10 in. of concrete, composed of 2½ parts of broken stone or screened gravel to 1 part of cement mortar made of 2 parts sand to 1 of F. O. Norton cement; over this concrete is a 6-in. layer of broken stones and then a 12-in. stone paving. The bottom of the reservoir is covered with a 6-in. layer of concrete sloping in all directions toward a 6 in. drain pipe.

Gate-House.—The 12-in. force main passes through and 38 ft. beyond the gate-house and terminates in an ⅛ in.-bend. The gate-chamber and gate-house are of brick, the former having 16-in. walls to the water-line and 12 in. above, the latter 12-in. walls all the way. Two check-valves and a gate regulate the flow in and out of the reservoir, water passing out going through two sets of ¼-in. mesh copper wire screens.

Distribution.—*Mains*, c. i., 17 miles. *Services*, iron. Cast-iron pipe was furnished by McNeal Pipe & Foundry Co., Burlington, N. J., and specials by Builder's Iron Foundry, Providence, R. I. *Taps*, 352. *Meters*, 48. *Hydrants*, Ludlow, Chapman, 97. *Valves*, kind, do.

Consumption, 125,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 119 lbs.

Financial.—Cost, $158,000. Bonded debt, $151,000. Int., 4%. Ann. op. exp., $2,500. Ann. rev.: consumers, $1,600; city, $1,990. Hydrant rental, $20.

Management.—Three Commrs. Supt., W. H. Vaughn.

NOTE:—For a more extended and fully illustrated description see *Eng. News*, vol. XIV., pp. 229-31. Also "The Wellesley Water Works," by Frank L. Fuller. An illustrated paper read before the Boston Society of Civil Engineers, June 17, '85 and printed in the Journal of the Association of Engineering Societies," vol. IV., pp. 401-12.

WESTBOROUGH, *Worcester Co.* (Pop., 5,214; est., 4,880.) On small tributary of Sudbury river, on uneven ground. Manufactures straw goods, boots and shoes. Settled in 1700; incorp. a town in 1717.

History.—Built in '78 by town. Engr., C. H. Pierce, Providence, R. I.

Water Supply.—Sandra pond, by gravity. The pond is two miles from and 134 ft. above center of town, is formed by building three dams, covers about 50 acres, and has a storage capacity of 45,000,000 galls.

Dams.—The first dam, at the outlet, was formerly a mill-dam and consisted of rock and gravel dumped on the natural surface. It has been strengthened by a stone and cement wall, laid in a trench below, 202 ft. long and from 4½ to 11 ft. high. Of the two other dams one was built across a bay with a puddle heart-wall 105½ ft. long resting for 89 ft. on quicksand through the center of which sheet piling was driven; the third dam is across a ravine, of gravel and loam, faced with a stone masonry wall 40 ft. long and 6 ft. high, is semicircular and used as a waste-way. The supply main is filled from a brick gate-house.

Distribution.—*Mains*, c. i., 9.5 miles. *Services*, w. i. *Taps*, 476. *Meters*, 31. *Hydrants*, Mathews, Chapman, 71. *Valves*, kind, do.

Consumption, unknown. *Pressure*: Ordinary, 55 lbs.

Financial.—Cost, $100,000. Bonded debt, $100,000. Int., 4 and 5%. Town appropriated $2,000 for sinking fund, in '88. Ann. op. exp., $4,707. Ann. rev.: consumers, $5,914; city, none. Hydrant rental, free.

WEST BROOKFIELD, *Worcester Co.* (Pop., 1,917; est., 1,800.)

History.—A small system built in '84 by town. Engr., E. C. Davis, Northampton. A fountain was presented to the town, to make use of which it was necessary to construct a dam and lay some pipe, after which the pipe was extended for fire protection.

Water Supply.—Brook, by gravity.

Distribution.—*Mains*, iron, 1½ miles. *Taps*, 5. *Hydrants*, Chapman, 3. There are also 8 small reservoirs used to store water for fire protection.

Financial.—Cost, $3,000. No debt.

Management.—Supt., Wm. Dane. Chf. Fire Dept., J. G. Shackley.

WESTFIELD, *Hampden Co.* (Pop., 7,587; est., 10,000.) On flat land along Westfield river, 10 miles from Springfield. Manufactures paper, steam heaters, whips and cigars. Settled in 1658; incorp. a town in 1669.

History.—Built in '74 by town. Engr., L. F. Root, Westfield. Consulting Engrs., Shedd & Sawyer, Boston.

Water Supply.—Moose Meadow, by gravity from storage to distributing reservoir. The brook has a drainage area of 4 sq. m.

Storage Reservoir.—Has an area of 30 acres, is 30 ft. deep, has a capacity of 184,000,000 galls.; it is 771.38 ft. above town.

Dam.—This dam is 350 ft. long, 20 ft. wide at top, with upper side paved with large stone; it has a heart-wall of stone and cement, 8 ft. thick above foundation and 3 ft. thick at its top which is 2 ft. above water line. There is an overflow around one end of dam, 20 ft. wide, paved with stone, and through the dam are two outlet pipes with gates, one 6-in., 5½ ft. from water surface, and one 20 in. at bottom of reservoir.

Distributing Reservoir.—Cap., 4,530 galls.; is 2½ miles from and 479 ft. below storage reservoir, water flowing between the two in the rocky channel of a brook; it is 4 miles from and 292 ft. above town.

Dam.—Is 193 ft. long, 7 ft. thick at overflow, 14½ ft. thick at bottom above foundation; 50 ft. above this a cut off-wall is built across the ravine and the space between filled with puddle; there is an overflow in two parts, total width, 30 ft.

Gate-House.—Below top of dam this is of stone lined with brick, and has inside dimensions of 12½ by 14½ ft. Water can be introduced either 5 or 14.6 ft. from the surface of the pond, but it is generally taken at the former; 6½ ft. lower a 20-in. waste-pipe extends through the dam. Arrangements are made to clean the gate-chamber and to filter the water before it passes to the town. Above the dam the gate-house is of brick, 18½ ft. sq. Contr., C. D. Allen, Westfield, who also did all the masonry work.

Supply Main.—Laid 4¾ ft. below surface, generally, and across Westfield river in trench through rock and gravel; is of 14-in. cast iron pipe, laid to a grade with an air-valve at each summit. The thickness and weight of the pipe is carefully graded to the pressure of each 50-ft. head.

Distribution.—*Mains*, w. i., 14 miles. *Services*, galv. i., rubber-coated i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and pipe laid by J. J. Marsh, North Adams. *Taps*, (in '86) 1,000. *Meters*, none. *Hydrants*, Ludlow, 121. *Valves*, Ludlow.

Consumption, (in '86) 1,000,000 galls. *Pressure*: Ordinary, 127 lbs. Fire, 127 lbs.

Financial.—Cost, $361,000. Debt, $240,000. Int., 4 and 6 %. Ann. op. exp., $2,073. Ann. rev.: consumers, $14,547; city, none.

Management.—Commrs. Chairman, C. M. Whipple. Clerk, Wm. Provin. Treas., Elbridge Axtell. Supt., C. H. Diehl.

WEST SPRINGFIELD, *Hampden Co.* (Pop., village, est., 3,000.) On Connecticut river. Detached from town of Springfield and incorp. in 1774.

History.—Built in '75 for private company. Engr., C. L. Goodhue, of Goodhue & Birnie, Springfield, who were contractors.

Water Supply.—Darby brook, by gravity from impounding reservoir of 5 acres area, formed by a puddle clay dam 250 ft. long and 17 ft. high.

Distribution.—*Mains*, w. i. and cement, 9 miles. *Services*, lead, enam. i. *Taps*, 340. *Meters*, none. *Hydrants*, 20.

Consumption, not given. *Pressure*: 40 lbs.

Financial.—Cost, $75,000. Capital stock, $50,000, Bonded debt, $25,000. No further financial data given.

Management.—Supt., M. L. Tourtelotte.

WEYMOUTH, *Norfolk Co.* (Pop., 10,570; est., 10,740.) Composed of the villages: Weymouth, Weymouth Landing, North Weymouth, East Weymouth and South Weymouth. The town is on the sea coast.

History.—Built in '85 by town. Engr., M. M. Tidd, Boston. Contr., Wm. C. McClallan, Chicopee.

Water Supply.—Weymouth Great pond, by gravity; and for South Weymouth pumping to stand-pipe, the pressure from which can be applied to all parts of the system, as can direct pumping. Pond is 154 ft. above sea-level, has an area of 300 acres, and a drainage area of 1,700 acres.

Conduit.—Begins in gate-house 93 ft. from shore-line and 11 ft. below high-water mark. The gate-house is of brick and stone, 8 ft. square inside, and within it is placed a 20-in. stop-gate on conduit and a double set of copper-wire screens. The first 100 ft. of the conduit is 20-in. cast-iron pipe, thence to pumping station, 18-in., where a 14-in. suction pipe takes the supply for South Weymouth and the gravity conduit is extended with 14-in. pipe to Broad and Middle streets; here a 12-in. pipe branches off through Broad street to Weymouth Landing and East Weymouth and a 10-in. pipe to North Weymouth, over King hill. Another 10-in. pipe gives a second connection with East and North Weymouth and Weymouth Landing.

Pumping Machinery.—Cap., 1,333,000 galls.; Blake compound duplex pumping engine with 10-in. high-pressure and 22-in. low-pressure cylinders, and 10-in. plungers, the whole of 18-in. stroke. The pumping station is about 2,300 ft. from pond and the centers of the pumps are on a level with high-water mark of pond.

Stand Pipe.—Cap., 706,860 galls.; the tank is of boiler iron 40 ft. in diam. and 75 ft. high. This is set upon a solid masonry foundation having chambers to give access to the inlet and outlet pipes. It was built by Cunningham Iron Works, Boston. It is connected with pumping engine by 6,500 ft. of 12-in. cast-iron pipe which passes through several streets and connects with distributing mains for South Weymouth, the stand-pipe thus storing the surplus for a reserve supply. The main enters the stand-pipe at the center of the bottom and rises 81 ft. above the bottom of the tank, thus making the top of center discharge pipe 118.9 ft. above engine-room floor and 266.4 ft. above mean high tide. The water from the tank passes out from the bottom through another 12-in. main and a check-valve which closes automatically when the pump starts up. The force and gravity mains also have a check-valve connection by means of which either the stand-pipe or direct pressure can be added to the gravity system.

Distribution.—*Mains*, c. i., w. i., 43.6 miles. Pipe furnished by A. H. McNeal, Burlington, N. J. *Services*, w. i., 6.1 miles. *Taps*, 1,318. *Meters*, none. *Hydrants*, Chapman, 303. *Valves*, Chapman.

Consumption, not given. *Pressure*: not given.

Financial.—Cost, $324,270. Bonded debt, $290,000. Int., not given. Ann. op. exp., $14,160. Ann. rev.: consumers, $14,311; city, $7,700, for hydrants and fountains.

Management.—Five Commrs. Supt., Geo. J. Ries. Pumping Engr., Geo. W. Sargent.

WHITMAN, *Plymouth Co.* (Pop., 3,024; est., 4,000.) Manufactures eyelets, tacks and boots and shoes.

History.—Built in '83-4 by town. Engr., Simpson C. Heald, Worcester. Contrs., Patent Water & Gas Pipe Co., Jersey City, N. J.

Water Supply.—Hobart pond, pumping to stand-pipe.

Pumping Machinery.—Worthington, dy. cap., 1,000,000 galls.

Stand-Pipe.—Made by Cunningham Iron Works, Boston; 20 ft. in diam. and 105 ft. high.

Distribution.—*Mains*, cement, 9 miles. *Services*, lead. Pipes and specials furnished by Davis & Farnum, Waltham. Pipe laid by J. R. Miller. *Meters*, Crown, Union, 126. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, $73,830. Bonded debt, $68,000. Int., 4%. Ann. op. exp., $5,000. Ann. rev.: not given. Hydrant rental, $20.

Management.—Three Commrs. Supt., J. C. Healy.

WILLIAMSTOWN, *Berkshire Co.* (Pop., village, 984; est., not given.) On Hoosac river, a favorite summer resort. Has some manufactories. Not incorp.

History.—Built in '59 by William's Aqueduct Co.

Water Supply.—Spring, by gravity. The spring is at the base of a high hill, 30 ft. above and 1¼ miles from village. There is a reservoir 41 ft. wide and 67 ft. long.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, 4.

Financial.—Cost, $15,000. Capital stock, $12,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $1,600; city, none.

Management.—Prest. and Treas., not given. Supt., Chas. G. Sanford.

WINCHESTER, *Middlesex Co.* (Pop., 3,082; est., 4,400.) On rolling ground, 8 miles from Boston. Place of residence for Boston business men. Has tanneries. Incorp. a town in '50.

History.—Built in '73 by town. Engr., Walter H. Sears, Plymouth. Contr., Chas. Lenehan, Cambridge.

Water Supply.—Surface water, by gravity from impounding reservoir; also high-service for about 45 takers, by pumping with windmill to reservoir.

Reservoirs.—An earthen dam, with stone masonry heart-wall, 30 ft. high and 600 ft. long is built across stream and forms impounding reservoir of 63 acres area and 260,000,000 galls. cap., 121 ft. above town. The high service reservoir is of stone and cement with brick lining, is 40 ft. in diam., 10 ft. deep, and has cap. of about 100,000 galls. An additional reservoir has been started which will cover 144 acres and have a depth or 37 ft. Work on this has been suspended after an expenditure of $75,000, which sum is not included in cost given below.

Windmill and Pump.—Former is 75 ft. high, with 30-ft. wheel driving a 5 in. pump and lifting water 87 ft. through 6-in. wrought iron and cement pipe.

Distribution.—*Mains*, w. i. and cement, 20 miles. *Services*, w. i. and cement. Pipe furnished and laid by Geo. H. Norman, Newport, R. I. *Taps*, 780. *Meters*, none. *Hydrants*, Boston, Newport, 80. *Valves*, Whittier Machine Co.'s.

Consumption, 250,000 galls. *Pressure*: Ordinary, 45 lbs.

Financial.—Cost, $160,000. Debt, $150,000. Int., 6 and 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $13,000; city, $1,200. Hydrant rental, $15.

Management.—Three Commrs. Registrar, Albert Ayer. Supt., Wm. T. Dotten.

WINTHROP, *Suffolk Co.* (Pop. 1,043; est., 1,400.) On Boston harbor, 5 miles from Boston.

History.—Built in '84 by Revere Water Co. All data included under Revere and Winthrop.

WOBURN, *Middlesex Co.* (Pop., 10,931; est., 12,760.) In a hilly region containing many natural lakes and ponds. Engaged in tanning and currying leather and manufacturing electric lamps. Settled in 1640; incorp. in 1642.

History.—Built in '73 by town. Des. Engr., Henry M. Wightman. Const. Engr., Clemens Herschel.

Water Supply.—Surface water from filter gallery near Horn pond, by direct pumping and pumping to reservoir. The pond has an area of 103 acres, a depth of 20 ft. and a drainage area of 7¼ sq. m.

Filter Gallery.—Is 12 by 82 ft., by 9 ft. deep with side walls of dry rough stone, and is covered by a semicircular brick arch. There is a pipe connection with the pond, but it has never been necessary to use it.

Pumping Machinery.—Worthington and Blake pumps, dy. cap., 2,000,000 galls. each.

Reservoir.—On Horn Pond mountain, 160 ft. above town and 220 ft. above pumps; 20 ft. deep and has cap. of 8,000,000 galls.

Distribution.—*Mains*, w. i. and cement, 40.3 miles. *Services*, w. i. and cement, enam. i. *Taps*, 4,209. *Meters*, 32. *Hydrants*, Chapman, Pattee & Draper, Whittier, 298. *Valves*, kind, do.

Consumption, 870,977 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $559,503. Debt, $450,900. Int., 3½, 4, 4½ and 6%. Ann. op. exp., $12,327. Ann. rev.: consumers, $26,752; city, $7,350. Hydrant rental, $25.

Management.—Three Commrs. Chairman, Chas. Porter. Registrar and Clerk, Albert P. Barrett. Pumping Engr., Oliver M. Wade. Supt., P. F. Criley.

WORCESTER, *Worcester Co.* (Pop., 58,291; est., 79,547.) On branch of Blackstone river, which affords a valuable water-power at this point. On uneven ground. Has various and extensive manufactories. Settled in 1675 and 1713; incorp. a town in 1722, a city in '48.

History.—First supply in 1798, by Dan'l Gooding under a State charter, the supply being from springs for domestic and fire purposes. In '45 the Worcester Aqueduct Co. was incorporated, taking its supply from Bell pond, 201 ft. above the town, and receiving $500 a year from the city. The population was then 11,556. In '52 these works were bought by the city.

Besides the above there were three other systems of supply in '64-5 when the city built the present works, the population being 28,000. Des. Engr., Phineas Ball, Worcester.

Water Supply.—Impounding reservoirs in Leicester and Holden, by gravity. The latter reservoir is on Lynde brook and was constructed by building the Lynde brook dam in connection with the new supply introduced in '64. The brook has a drainage area of 3 sq. m. The cap. of the reservoir in Holden is 450,000,000 galls. and of the Leicester, or Lynde brook, reservoir, 750,000,000 galls.

Lynde Brook Dam.—This dam is of especial interest as it gave way in '76, causing much damage. It was originally of earth, with rubble stone breasting wall and an 18-in. rubble stone and cement spiling wall, resting on hardpan. The earthwork was of good material well packed in 8-in. layers and with base puddled as well as it could be without cutting. The dam was 287 ft. long, 29 ft. high, and 137 ft. wide at base; it had an inner slope of 1 to 2, and a rubble stone paving from 12 to 18-in. thick. Extending through the dam was a 16-in. waste, and 12-in. outlet pipe, both of wrought iron lined and covered with cement. The outlet pipe was from 8 to 10 ft. below the original soil, imbedded in cement mortar.

In '70 the dam was raised 15 ft. and the base of the dam widened, before which all loose material under the new part was cleaned away. The foot-wall was removed and a new one laid far enough below to receive the slope of the enlargement, it being 11 ft. thick at the base and 14 ft. high. The spiling wall in the new part was placed 28 ft. lower down the valley than the old one, and consisted of two 18-in. rubble walls, parallel, and 4 ft. apart, filled between with concrete. The original outlet and supply pipes were cut off at the gate-houses and filled from that point with concrete and stone: the two gate-houses were also filled for 4 ft. with solid masonry. New gate-houses were constructed in a different place, 173 ft. apart, and were connected with two 24-in. pipes, one serving as a waste-pipe. These pipes were encased in a nearly semi-circular gallery, 8 by 7 ft., with double walls of split stone and cement mortar filled between with concrete, the whole thickness being about 4 ft. The walls were laid on the natural surface of compact gravel, and the bottom of the gallery was to be covered by an inverted arch, but owing to an influx of water from springs a horizontal paving was laid, first of flag-stones and later of Belgian blocks in cement. This was thought to be water tight, but water from springs and the reservoir worked through: neither was there any bonded connection made between the walls of the gallery and the spiling wall intersected by it.

Some apprehension was caused by the leakage from the dam, and after the Mill river disaster Jas. B. Francis of Lowell was employed to examine the dam. His report was made June 29, '74, and calls the weakest point in the dam the bottom of the gallery, and recommends that the leakage be constantly determined by a gauge below the dam. He also calls attention to the fact that the reservoir was kept filled at a higher level than was originally intended. For some time after putting in the weir the leakage varied but little, but in Sept., '75, City Engr., C. H. M. Blake reported an increased daily leakage of from 24,221 galls. in Apr. to 39,810 galls. in July, the leak being in the gallery 22 ft. from the upper gate-house and 20 ft. above the spiling wall. Oct. 22, '75, the leakage was 39,810 galls. Dec. 1 of the same year it rose to 48,448 galls., but through Jan., Feb., and up to Mar. 25, '76, it was again 39,810 galls. About this time the flash boards, which had been removed for some time, were put on to increase the supply and this, with the spring rains, increased the pressure upon the dam. Mar. 26-7 the leakage was again above 48,000 galls. Mar. 28 it rose to 67,000 galls., and on the next night water had risen in the gallery and a 3 by 4 ft. stream flowed through the lower gate-house windows. Owing to the jamming of the rods the waste-gate could not be opened and the flow increased all night. This leak was near the upper gate-house, about 30 ft. below the surface, and gravel, stones, hay and branches thrown in at this point failed to stop it. By 9 a. m., March 30, the dam began to settle and crack, while rocks and bags of hay below showed that the hole was increasing in size. Meanwhile an attempt was made to draw off the water gradually through a channel dug at the side of the dam. At noon the flow was diminished but the hole was working across the dam and the undermining continued. At 5 p. m. some material from the body of the dam evidently fell, for there was a lull in the stream, but in a short time another stream began to work through the dam just above the lower gate-house. This increased in size, washed away the earth from the masonry, left it unsupported and standing for a moment, then a flood of water began to rush through, sweeping away the lower gate-house, the upper gate-house with its heavy foundation wall, and leaving a final gap in the dam 80 ft. long, over 150 ft. wide and 20 ft. deep. In 1½ hours the water fell 16 ft. Owing to a warning of 24 hours there was no loss of life below the dam, but the destruction of the dam, mills, houses, railroad embankments and other property caused a loss of at least $750,000.

Subsequent examinations and reports showed the probable cause of failure just what Mr. Francis pointed out, the weakness of the gallery from the lack of an invert arch below to keep out all up-welling water, and this danger was increased by enlarging the storage capacity of the reservoir, as described above.

A new dam was built, after plans by W. J. McAlpine, and has stood well. The old heart-walls were removed and a puddle wall toothed into the original soil. All continual vertical and horizontal lines joining the old and new parts were broken up by benching and toothing. Three lines of cast-iron pipe were laid through the dam and enveloped in rubble masonry with three collars, or cross walls, all of irregular surface. During the repairs a temporary water supply was provided by damming Parson's brook with boulders and gravel, thus diverting it into the distributing reservoir, and by pumping from Coe's pond.

Distribution.—*Mains*, c. i., w. i. and cement, 110 miles. The w. i. and cement mains are being replaced with c. i. as rapidly as possible. *Services*, w. i. and cement. *Taps*, 8,110. *Meters*, 6,854. *Hydrants*, kind not given, 914.

Consumption, 4,000,000 galls. *Pressure*: low-service, 70 lbs.; high-service, 150 lbs.

Financial.—Cost, $1,776,178. Debt, $997,090. Int., 3½, 4 and %. Ann. op. exp., $94,146. Ann. rev.: consumers, $129,610: city, $2,000. The above figures are said to include maintenance and $25,000 paid for substituting cast-iron for cement-lined mains, but it is not stated whether these items were added to cost or operating expenses.

Management.—Commrs. Registrar, Geo. E. Batchelder. Supt., Jno. G. Brady.

NOTE:—For further details of these works and of failure of Lynde Brook Dam, see *Eng. News*, vol. III., pp. 108, 116, 125: vol. V., page 2, vol. VIII., p. 272. Also a report "On the Failure of the Worcester Dam" made by a committee from the American Society of Civil Engineers. Trans. Am. Soc. C. E., vol. V., pp. 244-50.

Water-Works Projected with Fair Prospects of Construction.

FAIRHAVEN, *Bristol Co.* (Pop., 2,875; est. 2,900.) On Acushnet river one mile from New Bedford. Summer resort. Has tack and iron works.

Proposed System.—Work to be finished in '88, by Fairhaven Water Co. Engr., O. G. Stanley, Vineyard Haven. Water to be pumped from deep wells to stand-pipe, with 100 lbs. pressure. Estimated cost, $50,000. Prest., Jas. K. Nye, New Bedford, who gave above information regarding the works.

An unofficial report states that the supply for fire purposes will be from Mill pond, that there will be a stand-pipe 100 ft. high with capacity of 235,000 galls. The ordinary pressure to be 40 to 50 lbs. and the fire pressure from direct pumping 90 to 100 lbs. The above contract for 20 years with 30 hydrants at $50 each.

Present Supply.—Wells.

MILTON, *Norfolk Co.* (Pop., 3,206; est., 3,600.) A place of residence for Boston merchants, in a farming country, 6 miles from that city.

Proposed System.—Water to be taken from either the Boston or Hyde Park Works, probably by a private company, the money to be raised by subscription and work to begin spring of '89.

Present Supply.—Ponds, wells and cistern, 5 hydrants. Town Clerk, H. B. Martin.

MONSON, *Hampden Co.* (Pop. 3,758; est., 4,000.) Has granite quarries, and manufactures carriages, woolen, cotton and straw goods.

Proposed System.—The Monson Water Co. hope to build works next year costing from $35,000 to $40,000. Capital can be easily secured. The source of supply is not yet decided upon but the mode will be by gravity. R. M. Reynolds can give information.

Present Supply.—Private aqueducts.

NEEDHAM, *Norfolk Co.* (Pop., est., 2,800.) Has hosiery and other manufactories.

Proposed System.—The town has been authorized to construct works if a two-thirds vote can be obtained in favor of same. So far, the project has failed, but it is hoped to obtain the vote within the two years allowed. Supply to be taken from Charles river or Rosemary brook, by pumping, probably to stand-pipe. Estimated cost, $50,000.

Present Supply.—Wells and cisterns. Town Clerk, C. C. Greenwood. Report made by Edgar H. Bowers.

WINCHENDON, *Worcester Co.* (Pop., 3,722; est., 4,000.) On Miller's river and has some manufactories.

Proposed System.—The town is now boring test-wells and if these prove satisfactory a choice will will be made between pumping from them to reservoir and a gravity supply to reservoir from Nankeag lake, 6¼ miles distant. It is estimated that the former supply would cost $63,000 and the latter $100,000. Engr., Walter Hale. Chairman Water Board, E. S. Merrill.

Present Supply.—Reservoirs and river.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Ashfield, *Franklin Co.* Housatonic, *Berkshire Co.* Ipswich, *Essex Co.*, Millbury, *Worcester Co.* Millville, *Worcester Co.* Oxford, *Worcester Co.* Sandwich, *Barnstable Co.*

RHODE ISLAND.

Water-Works Completed or in Process of Construction.

ASHTON, *Providence Co.* (Pop., not given.) A division of the Pawtucket Water-Works. All data included under Pawtucket.

BARRINGTON, *Bristol Co.* (Pop., 1,359; est., 1,400.)

History.—A system for domestic supply, built in '87 by Barrington Water Co. Engr. and Contr., Geo. H. Norman, Newport. The works were originally built to supply Nayatt Point, and still do so.

Water Supply.—Bristol Warren Water-Works Co.'s system.

Distribution.—*Mains*, w. i. and cement, 3 miles. *Services*, c. i. *Taps*, 30. *Meters*, 30. *Consumption*, not given. *Pressure*, 50 lbs.

Financial.—Cost, $15,000. No debt. No further financial data given.

Management.—Prest., Henry J. Steers. Treas., C. H. Merriman.

BLOCK ISLAND, *Newport Co.* (Pop. est., 1,300.) A summer resort on an island 20 miles at sea.

History.—Built in '88 by Block Island Water Co. Engr. and Contr., J. A. Hoar, Newport.

Water Supply.—Pond, pumping to stand-pipe.

Financial.—Cost, $10,000.

Management.—Prest., E. D. Payne. No further data given as works were not completed at time of report.

BRISTOL, *Bristol Co.* (Pop., 6,028; est., 5,800.) On Narragansett bay, 15 miles from Providence. Has good harbor. Engaged in gardening, boat-building and commerce, and manufacturing rubber and cotton goods. Incorp. a town 1747.

History.—Built in '82 by Bristol & Warren Water Works Co., whose system includes Warren and supplies Barrington and Nayatt Point, a summer resort. Engr., G. Norman Weaver, Newport. Contr., G. H. Norman, Newport.

Water Supply.—Kickenmit river, pumping to tank.

Pumping Machinery.—Boiler made by A. Russell & Son, Newburyport Mass. Knowles pump., dy. cap., 1,000,000 galls.

Tank.—Made by Cunningham Iron Works, Boston; 40 ft. in diam., by 35 ft. high; cap., 329,000 galls.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i. *Taps*, 350. *Meters*, 5. *Hydrants*, Chapman, 150. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $250,000. Capital stock, $250,000. No bonded debt. Ann. op. exp., not given. Ann. rev.: consumers, $10,000; Bristol, $2,000 and Warren $3,000 for hydrant rental.

Management.—Prest. I. F. Williams. Treas., G. Norman Weaver, Newport. Secy. Sidney Deane.

NOTE:—Items under History, Water Supply, Financial and Management refer equally to Warren.

CENTRAL FALLS, *Providence Co.* (Pop., 13,765; est., not given.) In town of Lincoln, on Blackstone river, one mile from Pawtucket and 5 from Providence. Manufactures thread, hair-cloth, machinery and cotton and woolen goods.

History.—Built in '81 by fire district.

Water Supply.—Pawtucket Water-Works.

Distribution.—*Mains*, iron, 11.5 miles. *Services*, w. i. *Taps*, 800. *Meters*, not given. *Hydrants*, kind not given, 72. (These figures for '86.)

Consumption, unknown. *Pressure*, Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Debt, $37,500. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $4,200; city, $1,000. (These figures for '86.)

Management.—The fire district operate the works, taking the supply from the Pawtucket Water-Works, the officers of which collect the rents and give Central Falls a rebate of 40 per. cent.

CRANSTON, *Providence Co.* A farming town adjoining Providence; its most thickly settled portions are just over the city line.

History.—Supplied in '76 by extensions for various distances of the Providence system. All data included under Providence.

DROWNVILLE, *Bristol Co.* (Pop., est., 300.)

History.—A system for domestic supply, built in '87 by Drownville Water Co.

Water Supply.—Wells, pumping to tank.

Pumping Machinery.—Furnished by Most, Foos & Co., Boston; pump driven by windmill.

Tank.—Cap., 52,000 galls.; is 16 by 21 ft., and was furnished by Most, Foos & Co., Boston.

Distribution.—*Mains*, Wyckoff, 2 miles. *Services*, Wyckoff. Pipe furnished by Ayrault Bros., Tonawanda, N. Y. *Taps*, 25. *Meters*, Union Co.'s, 7.

Consumption, 2,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, $6,500. Capital stock, $4,500. No bonds. Debt, $2,000. Int. not given. Ann. rev.: est. $300. Further data could not be given, as works had not been operated long.

Management.—Prest., David A. Waldron. Treas., Geo. T. Baker. Secy. and Supt., C. F. Anthony.

EAST GREENWICH, *Kent Co.* (Pop., 2,877; est., 5,000.) On Narragansett bay, 13 miles from Providence. Has bleaching works and cotton and woolen manufactories.

History.—Built in '86 by East Greenwich Water Supply Co. (National Water-Works Syndicate, Boston, Mass.) Engr., A. W. Forbes, Boston.

Water Supply.—Hunt's river, pumping to stand-pipe.

Pumping Machinery.—Boiler made by Whittier Machine Co., Boston. Worthington pump, dy. cap., 1,000,000 galls.

Stand Pipe.—Made by Cunningham Iron Work, Boston; cap., 160,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i. Pipe and specials made by R. D. Wood & Co., Philadelphia, Pa. Pipe laid by Ferris & Halladay, Jersey City, N. J. *Taps*, 180. *Hydrants*, R. D. Wood & Co.'s, 52. *Valves*, kind, do.

Consumption, 100,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 200 lbs.

Financial.—Cost, $100,000. Capital stock, $75,000. Bonded debt, $73,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers, $3,000; city, $1,500. Hydrant rental, $28.88

Management.—Prest., Geo. Alexander. Treas., B. C. Mudge. Both of 70 Kilby St., Boston, Mass.

EAST PROVIDENCE, *Providence Co.* (Pop., 5,056; est., 6,000.) On Providence river, about 1 mile from Providence. Engaged in oyster trade.

History.—Built in '80 by town. Engr., C. H. M. Blake. Contr., J. J. Newman, Providence. After the original plant was completed the distribution system was turned over to the Pawtucket Water-Works.

Water-Supply.—Pawtucket Water-Works.

Distribution.—Originally 8 miles of mains and 42 hydrants.

Financial.—East Providence receives a rebate of 25 per cent. on all rates collected from consumers.

All data included under Pawtucket.

JOHNSTON, *Providence Co.* A farming town adjoining Providence; its most thickly settled portions are just over the city line.

History.—Supplied in '73 by extensions of the Providence system. All data included under Providence.

LONSDALE, *Providence Co.* (Pop., 847.)

History.—The plant was built and operated as a part of the Lonsdale & Valley Falls Division of the Pawtucket Water-Works. All data included under Pawtucket.

NARRAGANSETT PIER, *Washington Co.* See Wakefield.

NAYATT POINT, *Bristol Co.*, (Pop., not given.) A small watering place near Barrington, Bristol and Warren.

History.—Supplied in '87 by Barrington Water Co., who take their water from the Bristol & Warren Water-Works Co. All data included under Barrington.

NEWPORT, *Newport Co.* (Pop., 15,693; est., 22,000, largely increased by summer visitors.) On Narragansett bay, on the summit and slopes of a hill. Has a good harbor, considerable commerce, and is a famous watering place. Settled in 1639; incorp. a city in 1784.

History.—Built in '76-7 by Geo. H. Norman, Newport, under a 50 years' franchise and owned by him till June, '81, when a company was organized and took possession of the works. Des. Engr., Geo. H. Norman. Const. Engr., G. Norman Weaver, Most of the work was done by the original owner.

Water Supply.—Easton's and Paradise ponds, pumping to reservoir from two stations, that at the first pond being one, and at the second, three miles from city. Easton's pond was formed by impounding the water of 4½ sq. m. drainage area by two dams of sand, one 2,800 ft. long, 15 ft. high and 12 ft. wide on top, with the water slope covered with rip-rap; the other 2,000 ft. long, 4 ft. high and 6 ft. wide on top. The pond has an area of 160 acres.

Pumping Machinery.—Combined dy. cap., 7,000,000 galls.; one Knowles of 19½-in. water cylinder and 36-in. stroke, one Carr-Selden of 12-in. water cylinder and 24-in. stroke, one Knowles high-pressure, and one 3,000,000 gall. Curtis pump. The lift from the first pumping station is 160 ft.

Distributing Reservoir.—Cap., 10,000,000 galls.; its flow line is 60 ft. above highest point in city.

Distribution.—*Mains*, c. i., w. i. and cement, 50 miles. *Services*, w. i. and cement. *Taps*, 2,500. *Meters*, Crown, Worthington, 12. *Hydrants*, kind not given, 220. *Consumption*, 1,000,000 galls. *Pressure*: Ordinary, 85 lbs.

Financial.—Cost, $700,000. Capital stock, $750,000. No debt. Ann. op.exp., $20,-000. Ann. rev.: consumers, $50,000; city, $10,000.

Management.—Prest., Geo. H. Norman. Secy., R. S. Franklin. Treas. and Supt., Wm. S. Slocum.

PAWTUCKET, *Providence Co.* (Pop., 19,030; est., 23,000; est. pop. supplied, 40,000.) On Pawtucket river, 4 miles from Providence. Engaged in manufacturing. Incorp. a town in '28, a city in '85.

History.—Built in '77 9 by city. Engr., Walter H. Sears. Supplies Ashton, Central Falls, East Providence, Lonsdale and Valley Falls.

Water Supply.—Abbott's run, by pumping to reservoir through distributing mains. Water is impounded by a dam forming Happy Hollow pond having a drainage area of 26 sq. m. and a capacity of 72,000,000 galls.

Pumping Machinery.-Two Corliss pumping engines, dy. cap., 3,000,000 galls. each. A new pumping station is being built with provisions for three 6,000,000-gall. pumps, water to be taken from a gravel filter bed near Blackstone river.

Reservoirs.—Cap., 21,000,000 galls.

Distribution.—*Mains*, c. i., 98 miles. *Services*, tarred w. i. *Taps*, 4,795, *Meters*, 2,900; mostly Crown and Union, with a few Desper, Worthington, Ball & Fitts' Duplex, Equitable and Empire. *Hydrants*, Fales & Jenks, 778. *Valves*, Chapman. *Consumption*, 3,176,193 galls. *Pressure*: Ordinary, 65 to 130 lbs. Fire, 65 to 130 lbs.

Financial.—Cost, $1,336,658. Debt, $1,336,658. Int., 4 and 5%. Sinking fund, $12,000. Ann. op. exp., $23,141. Ann. rev.: consumers, $82,000; cities, $14,868. Rebates were paid to the amount of $3,633. Hydrant rental, total, $12,640.

Management.—Three Commrs. Supt., Edwin Darling. Pumping Engr., Jno. H. Walker.

PAWTUXET, *Providence Co.* (Pop., 232.) Small village at mouth of Pawtucket river in towns of Cranston and Warwick and near Providence.

History.—Supplied in '80 by Providence Water-Works through 2 miles of 8-in. pipe owned by that city. All data included under Providence.

PEACE DALE, *Washington Co.* See Wakefield.

PHENIX, *Kent Co.* (Pop., 1,038; est., 1,000.) On Pawtuxet river, 10 miles west of Providence.

History.—Built in '85 7 by Pawtuxet Valley Water Co. Engr., H. B. Barton, Centreville. Contrs., Leach & Baldwin, Philadelphia, Pa. The system is being extended to supply River Point.

Water Supply.—Spring Lake brook, by gravity. There is a reservoir with an area of 17 acres.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry and Machine Co., Phillipsburg, N. J. *Taps*, 90. *Meters*, Crown, number not given. *Hydrants*, Ludlow, 41. *Valves*, Ludlow. *Pressure*: Ordinary, 80 lbs.

Financial.—Capital stock, $100,000. Bonded debt, $50,000. Int., 5%. Ann. rev.: city, $1,230. Hydrant rental, $30.

Management.—Secy., Vernum A. Bailey. Supt., Albert F. Hill.

NOTE:—When extensions are completed there will be 11 miles of pipe and 104 hydrants.

PROVIDENCE, *Providence Co.* (Pop., 104,857; est., 125,000.) At head of navigation on Narragansett bay, 35 miles from ocean. Two small rivers meet in center of city and on the east is the Blackstone river, which near its mouth becomes a tida basin called Seekonk river. The confluence of these three rivers forms the Providence river. The business part of the city is near the river and about 10 ft. above tide-level; a second part rises on each side of the river 75 ft. above tide-level, while a small section is at an elevation of from 90 to 200 ft. Engaged largely in commerce and manufacturing. Settled in 1636; incorp. a city in '32.

History—Built in '70 6 by city. Engr., J. Herbert Shedd, Providence. The city also supplies other parts of Cranston, and those parts of Johnston and North Providence within one mile of city limits, and the village of Pawtucket. The terms are the same as for Providence.

The first public water supply was introduced in 1772 by a company who distributed spring water through ¾ miles of wooden logs. In the same year the "Rawson's Fountain Society" collected spring water in a reservoir 13½ by 30 ft. and 10 ft. deep from which water was conveyed through 6,600 ft. of 4-in. wooden logs. The Providence Water Co. also built two fountains or small reservoirs. From these water was supplied to families for $10 each.

Water Supply.—Pawtucket river by direct pumping and pumping to reservoir. The river has a drainage area of 192 sq. m. and empties into the Providence river 5 miles below the city. The Pettaconsett pumping station is 4 miles from the river's mouth, and at this point water is taken from a basin excavated in the porous and saturated sand near the river bank, there being provision for drainage directly from the river.

Pumping Machinery.—Combined dy. cap., 33,000,000 galls.: 5,000,000-galls. Worthington; 9,000,000 and 5,000,000-gall. Corliss; 9,000,000-gall. Cornish; and 5,000,000-galls. Nagle pumping engines.

Reservoir.—Two, combined cap., 125,000,000 galls. The Sockanossett reservoir is 180 ft. above pumping station, has a water surface of 11 acres and a cap. of 50,000,000 galls.; it is in excavation and embankment, the slopes being lined with 6 in. of broken stone upon which is laid a 15-in. dry stone wall. The Hope high service reservoir is 162½ ft. above high-tide, irregular, about 840 by 950, ft. and 24½ ft. deep, and has a cap. of 75,000,000 galls. A new high service reservoir is being built. Cont., J. J. Newman, Providence.

Distribution.—*Mains*, c. i., 202 miles. *Services*, lead. *Taps*, 13,128. *Meters*, 7,623. *Hydrants*, Providence, 1,278.

Consumption, 4,924,915 galls. *Pressure*: Ordinary, 39 to 73.

Financial.—Cost, $6,234,672. Debt, $5,500,000. Int., 5 and 6% Ann. op. exp., $69,828. Ann. rev.: consumers, $313,561; city, $37,020,

Management.—Water Board: Prest., C. E. Carpenter.

NOTE:—For a more detailed account see *Eng. News*, vol. VIII., pp. 195, 202; also for full description and illustration of distribution system, vol. XV., pp. 258 and 274-6.

RIVER POINT, *Kent Co.* (Pop., not given.)

History.—The River Point fire district contracted with the Pawtuxet Valley Water Co. in the summer of '88 for a supply of water. There will be 6 miles of pipe. Engr., Herbert B. Barton. No other data given.

VALLEY FALLS, *Providence Co.* (Pop., 1,861: est., 2,000.) Near Pawtuxet. Has some manufactories. A part of the Lonsdale and Valley Falls Division of the Pawtucket Water-Works. All data included under Pawtucket.

WAKEFIELD, *Washington Co.* (Pop., to be supplied, est., 3,000 permanent, with 6,000 in summer.)

History.—The Wakefield Water Co. began construction of works, July '88, to supply Wakefield, Narragansett Pier and Peace Dale. Engr., J. Herbert Shedd, Providence. Contr. for pipe-laying, F. B. Durfey, Norwich, Conn.

Water Supply.—Water bearing gravel, near Saugatuck river, Peace Dale; by pumping to stand-pipe 190 ft. above tide-level. The area to be supplied is generally from 10 to 60, and at extreme points, 130 ft. above tide-level.

Financial.—Est. cost., $133,000.

Management.—Prest., Richard Pancoast, 68 Wall St., New York City.

NOTE:—The above data was published in *Eng. News*, vol. XX., p. 158, and in a letter from the President of the company, published in the same vol., p. 218, is claimed to be inaccurate, in minor details, but no corrections have yet been given.

WARREN, *Bristol Co.* (Pop., 4,007; est., 4,050.) On Narragansett Bay, 10 miles from Providence. Has good harbor. Manufactures cotton goods. Incorp. a town in 1747.

History.—Built in '82 by Bristol & Warren Water-Works Co.

Distribution.—*Mains*, w. i. and cement, 8 miles. *Services*, w. i. and cement. *Taps*, 224. *Meters*, none. *Hydrants*, Chapman, 58. *Valves*, Chapman.

Consumption, 250,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Management.—Supt., Benj. B. Martin.

NOTE:—All other data included under Bristol.

WESTERLY, *Washington Co.* (Pop., 6,104; est., 9,000.) On Pawtucket river, the village being partly in Conn. Engaged in quarrying granite and manufacturing cotton and other goods. Incorp. in 1669.

History.—Built in '86 by Westerly Water-Works Co. Des. Engr., J. Herbert Shedd, Providence. Const. Engr., Wm. M. Brown, Jr. Contrs., Adam Miller & Co., Saratoga, N. Y., and F. A. Snow, Providence; for masonry, Henry Champlin, and for buildings, Randolph, Bentley & Co., both of Westerly.

Water Supply.—Shunoc brook, pumping to stand-pipe.

Pumping Machinery.—Two Babcock & Wilcox boilers; two Worthington compound condensing pumps, dy. cap., 750,000 galls each.

Stand-Pipe.—Made by Robinson Boiler Works, Boston; 30 ft. in diam. and 70 ft. high.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. Pipe furnished by McNeal Pipe & Foundry Co., Burlington, N. J., M. J. Drummond, New York City and Gloucester Iron Works, offices, Philadelphia, Pa. *Taps*, 180. *Meters*, 85. *Hydrants*, Chapman, Ludlow. *Valves*, kind, do.

Consumption, 125,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 90 lbs.

Financial.—Cost, $125,000. Bonded debt, $100,000. Int., 5%. No further financial data given.

Management.—Prest., Jas. M. Pendleton. Treas., Chas. Perry, Jr. Supt., Everett Barns.

WOONSOCKET, *Providence Co.* (Pop., 16,050; est., 17,000.) On Blackstone river, 16 miles from Providence. Manufactures machinery, cotton, woolen and rubber goods. Incorp. in '67.

History.—Built in '84, now owned by city. Engr., J. W. Ellis. Contr., Jno. W. Rutherfoord, New York City; for buildings, Wm. E. Hubbard, Woonsocket.

Water Supply.—Crook Falls brook, pumping to tank.

Pumping Machinery.—Worthington compound duplex directing acting pump, dy. cap., 1,500,000 galls.

Tank.—Made by Cunningham Iron Works, Boston; 50 ft. in diam. and 30 ft. high.

Distribution.—*Mains*, c. i., 21.85 miles. *Services*, lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., Pancoast & Rogers, New York City and McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 761. *Meters*, 674. *Hydrants*, Chapman, 334. *Valves*, Chapman.

Consumption, 269,648 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost $319,871. Debt, $300,000. Int., 4%. Ann. op. exp., $7,346. Ann. rev.: consumers, $10,940; city, $10,263.

Management.—Supt., Willard Kent.

Water-Works Projected with Fair Prospects of Construction.

BURRILVILLE, *Providence Co.* (Pop., est., 5,124.) Manufactures cotton and woolen and other goods.

Proposed System.—The Burrilville Water Co. propose to take water from Wallum pond, by gravity, and have made surveys for this and another plan. The town has voted twice on the question, once rejecting the proposition, and later, postponing action. The National Water-Works Syndicate, 70 Kilby St., Boston, Mass., are interested.

CENTREVILLE, *Kent Co.* (Pop., not given.) A village in town of Warwick.

Proposed System.—See Coventry.

COVENTRY, *Kent Co.* (Pop., whole town, 4,519; est., 5,000.)

Proposed System.—The Warwick and Coventry Water Co. were organized in June, under a State charter, to supply water to the villages in Warwick and Coventry about the south branch of the Pawtucket river. $50,000 stock has beeen issued. Supply will be from wells by pumping to stand-pipe. Eventually, a population of 8,000 will be supplied, requiring 14 miles of pipe, but at present only three villages, with a population of 4,000, will be supplied. This will require 6¼ miles of pipe and

60 hydrants. Prest. of Co., E. Lapham. Secy., H. B. Barton, Centreville, Engr. for town of Warwick.

WARWICK, *Kent Co.* (Pop., whole town, 12,164; est., 13,500.)
Proposed System.—See Coventry.

CONNECTICUT.

Water-Works Completed or in Process of Construction.

AMESVILLE, *Litchfield Co.* (Pop., 377.) At head of Great Falls of Housatonic river, ½ mile from post-office of Falls Village; the site of the repair shops of the Housatonic R. R. Co.

History.—A small system for supplying the shops and village was built by the R. R. Co. in '72. Engr., W. E. Pettee.

Water Supply.—Spring, by gravity. The spring is 170 ft. above shops, is collected in a small stone basin and conducted through the distributing main in the village to a small reservoir. There are about 50 taps and 4,500 ft. of w. i. mains. No fire hydrants. Works are managed by the Master Mechanic of the shops. More details are given in *Eng. News*, vol. x., p. 135.

ANSONIA, *New Haven Co.* (Pop., 3,855; est., 8,000.) On Naugatuck river, 10 miles from New Haven, in narrow valley between steep sand hills. Manufactures clocks, brass, copper and woolen goods.

History.—Built in '69 by Ansonia Water Co.

Water Supply.—Surface water, by gravity and direct pumping.

Reservoirs.—Three, covering about 14 acres. The first reservoir was formed by a stone dam across a small stream; it was 220 ft. above village and had a cap. of 10,000,000 galls.

Pumping Machinery.—In factory.

Distribution.—*Mains*, w. i. and cement, 7 miles. *Services*, galv. i. *Taps*, 300. *Meters*, 5. *Hydrants*, Chapman, 53. *Valves*, Chapman.

Consumption, 275,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $120,000. Capital stock, $30,700. Bonded debt, $58,500. Int., 5%. Ann. op. exp., $2,100. Ann. rev.: consumers, $7,000; city, $1,600. Hydrant rental, $28.

Management.—Prest., Thos. Wallace. Secy. and Supt., D. Bartholomew.

BETHEL, *Fairfield Co.* (Pop., 1,767.) In valley surrounded by high hills. Incorp. a borough in '48.

History.—Built in '78 by borough. Engr., W. B. Rider, South Norwalk. Contr., D. A. Chappell, Chicago.

Water Supply.—Surface water, by gravity from impounding reservoir on small stream.

Reservoir.—Formed by an earth dam 200 ft. long and 20 ft. high, with heart-wall of rubble masonry; has an area of 25 acres, cap. of 84,000,000 galls., and is 175 ft. above and 1½ miles from village.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 416. *Meters*, none. *Hydrants*, Mathews, 56. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $3,900; city, none.

Management.—Three Commrs.: Secy., Fred Shepard. Supt., E. C. Oakley.

BIRMINGHAM, *New Haven Co.* (Pop., 3,026; est., 7,000.) At junction of Housatonic and Naugatuck rivers.

History.—Built in '60 by Birmingham Water Co., who also supply the village of Derby.

Water Supply.—Springs and surface water, by gravity from reservoirs.

Reservoirs.—One of 9 and one of 27 acres area; their sites were formerly swamps.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 406. *Meters*, 6. *Hydrants*, kind not given, 50 public.

Consumption, unknown. *Pressure:* 60 to 100 lbs., varying with elevation.

Financial.—Cost, $100,000. Capital stock, $65,000. Debt, $23,000. Int., 5%. Ann. op. exp., $2,300. Ann. rev.: consumers, $8,500; city, $1,500.

Management.—Prest., Wm. B. Wooster. Secy. and Treas., David Torrance. Agt. and Supt., Chas. H. Nettleton.

BRIDGEPORT, *Fairfield Co.* (Pop., 27,513; est., 45,000.) On an inlet of Long Island Sound, at mouth of Pequonnock river; mostly on small plain, back of which is Gold hill rising to the height of 60 ft. and covered with residences. Has many manufactories. Incorp. a borough in '20, a city in '35.

History.—The first system was built in '18 by Rev. Elijah Waterman, who conveyed water through wooden pipes from springs on Gold hill. These works changed hands in '23 and '48, having been extended from time to time. In '53 Nathaniel Green started a company which in '57 became the Bridgeport Hydraulic Company. In '86 the Citizens Water Co. began the construction of works with Hull & Palmer, Bridgeport, as Engrs., Coles & Jellette, Contrs., and Jacoby & Malden Sub-Contrs. for pipe laying; the pipe and hydrants were bought of R. D. Wood & Co., Philadelphia, Pa. An injunction was served by the Bridgeport Hydraulic Co., which prevented the new company from bringing their mains inside the city. Later, the two companies consolidated and in '88 connection was made between the two systems.

Water Supply.—The Bridgeport Hydraulic Co. took their supply from Ox and Island brook and Pequonnock river and the Citizens water Co. from Mill river. Both were gravity systems, a pump being used only in extreme droughts.

Reservoirs.—A 50,000,000 gall. storage reservoir was built on Ox brook, an 80,000,000 one on Island brook, and in '78 an 180,000,000-galls. reservoir on Pequonnock river, 175 ft. above tide-level and having an area of 50 acres and a depth of 10 ft. The Citizen's Co. had a 50-acre reservoir containing 245,000,000 galls. No data has been given regarding the distributing reservoir, but the first three storage reservoirs were connected with it.

Pumping Machinery.—Worthington, 16-in. cylinder and 48-in. stroke. Seldom used.

Tunnel.—In connection with Mill river supply, 2,700 ft. long.

Distribution.—*Mains*, w. i. and cement, 60 miles in '83; 6 miles added by Citizens Water Co. *Services*, lead and w. i. *Taps*, 3,500 in '83. *Hydrants*, R. D. Wood & Co.'s, 192.

Financial.—Cost, $800,000 in '83; the works of the Citizen's Water Co., cost $325,000 and their capital stock was $300,000.

Management.—Supt., Geo. Richardson.

BRISTOL, *Hartford Co.* (Pop., 2,763; est., 4,000.) Is 17 miles west of Hartford. Manufactures clocks, hardware and knit goods.

History.—Built in '85 by Bristol Water Co. Des. Engr., H. W. Ayers. Const. Engrs., H. W. Ayers and R. D. Barnes.

Water Supply.—Poland brook, by gravity. There is a reservoir of 28 acres area.

Distribution.—*Mains*, c. i., 13.9 miles. *Services*, galv. i. *Taps*, 250. *Meters*, 2. *Hydrants*, Ludlow, 67. *Valves*, Ludlow,

Consumption, 400,000 galls. *Pressure*: Ordinary, 60 to 130 lbs, varying with elevation. Fire, same.

Financial.—Cost, $100,000. Capital stock, $60,000. Bonded debt, $40,000. Int., 5%. Ann. rev.: city pays $1,200 for 59 hydrants. Other financial data withheld.

Management.—Prest., J. H. Sessions. V. Prest., N. L. Birge. Secy. and Treas., C. S. Treadway. Supt., T. H. Keirns.

CANAAN, *Litchfield Co.* (Pop., est., 600.) One mile west of Housatonic river, on a sandy plain broken by limestone ridges rising from 10 to 100 ft. above river-level, the village being 670 ft. above sea-level. Settled in 1740.

History.—Built in '79 by Canaan Water Co. Engr., W. A. Pattee.

Water Supply.—Springs, by gravity from impounding reservoir formed by a stone masonry dam 150 ft. long and 12 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 90. *Meters*, none. *Hydrants*, Chapman. *Valves*, Peet.

Consumption, unknown. *Pressure*, Ordinary, 95 lbs. Fire, 35 lbs.

Financial.—Cost, $8,000. Debt, none. Ann. op. exp., $150. Ann. rev.: consumers, $700; city, none.

Management.—Prest., Luman Foot. Treas., J. W. Peet. Secy., S. A. Eddy. Supt., S. A. Bennett.

CONNECTICUT STATE INDUSTRIAL SCHOOL FOR GIRLS, *Middletown, Essex Co.* (Pop., not given.)

History.—Built in '80 by school. Engr., E. P. Augur.

Water Supply.— Springs and surface water, by gravity from a 2,500,000-gall. impounding reservoir formed by a 300-ft. earth dam with puddle wall in center.

Distribution.—*Mains*, w. i. and cement, 1.4 miles. *Services*, lead, w. i. *Taps*, 40. *Meters*, none. *Hydrants*, Holyoke, 4. *Valves*, Holyoke.

Consumption, 300 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $12,000. No debt, expense or revenue.

Management.—Supt., Wm. G. Fairbank.

DANBURY, *Fairfield Co.* (Pop., 11,666; est., 17,000.) Has manufactories. Incorp. a borough in '22.

History.—Built in '61 by borough. Engr., Jno. W. Bacon. In '33 water from springs for domestic use was introduced through 1-in. lead pipes by the Danbury Water Co. In '81 many families were still supplied through this system.

Water Supply.—Surface water, by gravity from impounding reservoirs.

Reservoirs.—First one was formed by an earth dam 300 ft. long by 25 ft. high built across small stream; elevation, 200 ft. above main street of village; area, 6 acres, and cap., 40,000,000 galls. In '66 a second reservoir was built further up stream covering 30 acres and holding 150,000,000 galls. In '69 both dams were carried away by the failure of the upper one, caused by the frost penetrating to water line. Both dams were immediately rebuilt and have stood well. In '81 a stone dam was built on another stream at an elevation of 200 ft. Engr., Wm. E. Worthen.

Distribution.—*Mains*, w. i. and cement, 35 miles. *Services*, galv. i. *Taps*, 2,600. *Meters*, none. *Hydrants*, Holyoke, 204. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $240,000. Bonded debt, $232,000. Int., 4 and 4½%. Ann. op. exp., $3,000. Ann. rev.: consumers, $24,000; city, none.

Management.—Secy., N. T. Bulkley. Supt., L. K. Mansfield.

DANIELSONVILLE, *Windham Co.* (Pop., 3,118; est., 4,000.) In Killingly and Brooklyn townships, on Quinnebaug river. Manufactures shoes, shuttles, belts and cotton and woolen goods.

History.—Built for domestic supply in '86 by Crystal Water Co. Engr., F. C. Kimball, Boston, Mass. Contr. for masonry, I. G. Wright.

Water Supply.—Springs, by gravity. There is a reservoir of 5 acres area.

Distribution.—*Mains*, w. i. and cement, length not given. *Services*, iron. *Meters*, 1. *Hydrants*, none.

Consumption, unknown. *Pressure*: 57 lbs.

Financial.—No data given.

Management.—Prest., T. E. Hopkins. Secy., M. P. Dowe. Treas., Elbert Wheeler, 24 Washington St., Boston, Mass.

NOTE:—No contract for hydrants has yet been made. When this is done an additional 3 miles of pipe will be laid, and probably more complete data can be given.

DERBY, *New Haven Co.* (Pop., est., 4,000.) A village in town of Derby, near Birmingham. Has various manufactories.

History.—Supplied in '60 by Birmingham Water Co. All data included under Birmingham.

DURHAM, *Middlesex Co.* (Pop., 990; est., 1,000.)

History.—Built for domestic supply in 1793 and rebuilt in '32 by Durham Aqueduct Co., which consist of the heads of about 40 families.

Water Supply.—Cold spring, by gravity. Spring walled up 4 by 5 ft., by 4 ft. deep.

Distribution.—*Mains*, w. i. and cement, 1.8 miles. *Services*, lead. *Taps*, 41. *Consumption*, unknown.

Financial.—A tax is levied on each family annually to meet expenses for repairs. No other data given.

Management.—Three Directors: Prest. S. S. Scranton, D. B. Coe and S. Hubbard.

GREENWICH, *Fairfield Co.* (Pop., 942; est., not given.) 27 miles east of New York City on Long Island Sound. Place of residence for many New York business men.

History.—Built in '80 by Greenwich Water Co. Des. Engr., W. B. Rider, South Norwalk. Const. Engr. Jno. W. Rutherfoord and Wm. S. Barrett. Contr., Wm. Sherman.

Water Supply.—Surface water, by gravity from reservoir of 70 acres area.

Filters.—In '87 or '88 four filters were put in by Hyatt Pure Water Co., New York City.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 275. *Meters*, none. *Hydrants*, Mathews, 27.

Consumption, unknown. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost (in '82) $84,000, and no debt then. Hydrant rental, $29.63. No further data given.

Management.—Supt., Jno. Dayton.

HARTFORD, *Hartford Co.* (Pop., 42,015; est., 48,000.) On Connecticut river at head of sloop navigation. Engaged in commerce and manufacturing. Settled in 1735; incorp. a city in 1784.

History.—Built in '51 by city when population was about 20,000. These works consisted of a pumping station and 8,000,000 gall. reservoir on Asylum hill, 6,876 ft. distant. Water was taken from Connecticut river. The pumping machinery was designed by Wm. Wright and built by Woodruff & Beach. This supply is seldom used now, gravity works having been built in '65-7. Engrs. of the latter, Geo. Marsh and Saml. M. Gray.

Water Supply.—As above; and surface water by gravity from 5 reservoirs.

Reservoirs.—Combined cap., 1,300,000,000, galls., as follows: 145,000,000, 285,000,000, 145,000,000, 95,000,000 and 600,000,000 galls. respectively. One of the dams, the first constructed in connection with the gravity works, gave way in '67. It was an earthen dam 53 ft. high, 782 ft. long, forming a reservoir covering 32 acres, and at that time having a capacity of 165,000,000 galls., and a flow line 260 ft. above low water in Connecticut river. Partly constructed dam above, and on the same stream, was carried away by a heavy rain; the extra volume of water washed the banks of the reservoir, rose above the puddle wall of the lower dam, cut a channel over its top which increased in size until the whole dam gave way and discharged 200,000 000 galls. of water into the valley below, causing much damage. This was in Sept., and by Dec. of the same year a dam had been rebuilt under the direction of W. J McAlpine. This dam forms reservoir No. 1, and is on Trout brook. Above it are two others known as No. 3 and No. 4. The latter is formed by an earth dam across the ravine, with a puddle foundation in the center, 25 ft. wide and carried to rock 19 ft. below bed of stream; it has a dam 170 ft. long at bottom and 560 at top with a height of 42½ ft. above bed of stream. The inside slope is 3 to 1, covered with 30 in. of riprap, and the outer, 2 to 1, sodded. About 6 acres of muck at the upper end of the reservoir were covered with 3 ft. of gravel. No. 3 and 4 are covered with a 12-in. pipe. In '77 the dam of this reservoir leaked and was repaired by drawing off the water and laying a strip of puddle wall along the bottom of the dam, inside. In '79 the waste-gate of the reservoir connected with the old pumping system was opened by some unknown person and the reservoir suddenly emptied; the slope walls slid into the reservoir, necessitating repairs.

In '80 reservoir No. 2 was built in a ravine receiving the discharge of two brooks. Engr., W. E. Worthen. The dam is an earth embankment, built in 6-in. layers, well watered and rolled. The surface was excavated to hard rock, a concrete heart-wall built, and the remainder of the trench filled with puddle. A second dam, 1,200 ft. long, was built to prevent water from backing across the divide at the upper end of the reservoir. An open conduit and 561 ft. of 16-in. cement pipe connect this reservoir with No. 1, 15,840 distant.

Conduit.—From reservoir No. 1 at West Hartford, originally 20-in. wrought iron and cement pipe which lasted from 6 to 10 years. The cement separated from the iron, which then rapidly oxidized, and the hemp-caulked joints were very leaky in soft ground. This is being replaced by cast-iron pipes.

Distribution.—*Mains*, c. i., w. i. and cement, 80 miles. *Services*, galv. i. *Taps*, 5,836. *Meters*, 315. *Hydrants*, Ludlow, Holyoke, 476. *Valves*, Ludlow.

Consumption, 500,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $1,697,338. Debt, $857,000. Int., 5 and 6%. Ann. op. exp., $28 415. Ann. r. v.: consumers, $146,945; city, $11,000. Hydrant rental, $20.

Management.—Six Commrs. Prest. and Supt., Ezra Clark. Secy., J. Seymour Chase. Engr. in charge of reservoirs, Henry W. Ayers. Inspector, Albert A. Fox.

KENT, *Litchfield Co.* (Pop., est., 250.)

History.—Built in '82 by Kent Water Co. Engr., W. B. Rider, So. Norwalk. Contr., C. T. Leonard & Son, So. Norwalk.

Water Supply.—Springs and surface water, by gravity from reservoir of 1¼ acres area and from 2 to 18 ft. deep.

Distribution.—*Mains*, c. i., 2.3 miles. *Services*, w. i. *Taps*, 40. *Meters*, none. *Hydrants*, Mathews, 10. *Gates*, Ludlow or Chapman.

Consumption, unknown. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $15,500. Capital stock, $15,000. No debt. Ann. op. exp., $55. Ann. rev.: consumers, $500; city, none. Hydrant rental, free.

Management.—Prest., L. Eaton. V. Prest., Secy. and Supt., C. A. Eaton. Treas., C. H. Gaylord.

MERIDEN, *New Haven Co.* (Pop., 15,500; est., 23,000.) In rolling country. Manufactures silver-plated and Britannia goods, cutlery, steel pens, guns, glassware, cabinet organs and all kinds of hardware. Incorp. a city in '67.

History.—Built in '69 by city. Engr., Geo. H. Bishop.

Water Supply.—Surface water, by gravity from impounding reservoir.

Reservoir.—Cap., 300,000,000 galls; formed by two earth dams, 25 ft. high, built between two high hills 1 mile from and 250 ft. above village.

Distribution.—*Mains*, c. i., w. i. and cement, 30.4 miles. *Services*, galv. i. *Taps*, 2,576. *Meters*, 74. *Hydrants*, Chapman, Mathews, Whittier, Holly, 203. *Valves*, Chapman, Ludlow.

Consumption, 1,300,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 115 lbs.

Financial.—Cost, $374,028. Debt, $325,000. Sinking fund, $90,000. Int., 7%. Ann. op. exp., $3,628. Ann. rev.: consumers, $43,578; city, $6,300. Hydrant rental, $30.

Management.—Supt., Jno. B. Dunlap.

MIDDLETOWN, *Middlesex Co.* (Pop., 6,826; est., 10,000.) On Connecticut river, on ground rising from river 175 ft. in ¾ miles. Has many manufactories and large trade. Settled in 1650; incorp. a city in 1784.

History.—Built in '66 by city. Engr., Geo. A. Bishop.

Water Supply.—Surface water, by gravity from impounding reservoir taking drainage from ½ sq. m.

Reservoir.—Formed by earth dam across ravine; covers 76 acres, has average depth of 10 ft. and is 168 ft. above main business street and 45 ft. above highest residence district.

Filter.—A double wall of brick filled between with stone and gravel. No way was provided for cleaning this and in warm weather water is better from outside.

Distribution.—*Mains*, c. i., w. i. and cement, 18 miles. *Services*, galv. i., w. i. and cement. *Taps*, 1,200. *Meters*, 8. *Hydrants*, Holyoke, Ludlow, 100. *Valves*, Eddy, Chapman.

Consumption, 750,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial—Cost, $244,642. Debt, $139,000. Int., 3.65, 4 and 6%. Ann. op. exp., $3,800. Ann. rev: consumers, $17,100; city, $2,900. Hydrant rental, $25 and $30.

Management.—Commrs. Secy. and Supt., J. C. Broatch.

MYSTIC, *New London Co.* (Pop., not given.)

History.—To be supplied by Mystic Valley Water Co., work now in progress. All data received is included under Stonington.

NAUGATUCK, *New Haven Co.* (Pop., 4,274; est., 6,0000.) Is 5 miles from Waterbury. Engaged in manufacturing.

History.—Work begun Aug. 4, '88, by Naugatuck Water Co. Engr., T. H. McKenzie, Southington. Contr., Franklin A. Snow, Providence, R. I.

Water Supply.—Straitsville brook; by gravity. There will be a reservoir.

Distribution.—*Mains*, iron.

Financial.—Cost, est., $80,000. Capital stock, $40,000.

Management.—Prest., Homer Twitchell. Secy. and Treas., S. S. Scott.

NEW BRITAIN, *Hartford Co.* (Pop., 11,800; est., 20,000.) Is 10 miles from Hartford. Manufactures knit goods, jewelry and hardware. Incorp. a borough in '50, a city in '73.

History.—Built in '57 by city. Des. Engr., McRee Swift. Const. Engr., A. B. Chamberlain.

Water Supply.—Shuttle Meadow pond, by gravity to a distributing reservoir. Pond is formed by a stone dam across brook of same name, having drainage area of 1 sq. m. Pond has area of 175 acres, cap. of 700,000,000 galls. and is 175 ft. above city.

Distribution.—*Mains*, c. i., w. i. and cement, 27 miles. *Services*, w. i. *Taps*, 3,500. *Meters*, 54. *Hydrants*, Chapman, Holyoke, 190. *Valves*, kind, do.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $250,000. Bonded debt, $171,000. Int., 4 and 7%. Ann. op. exp., $3,862. Ann. rev.: consumers, $31,026; city, $4,450. Hydrant rental, $25.

Management.—Three Commrs. Prest., J. E. Dunlap. Clerk, J. W. Ringrose. Supt., D. A. Harris.

NEW HAVEN, *New Haven Co.* (Pop., 62,882; est., 80,000.) At head of New Haven bay, 4 miles from Long Island Sound; on a sandy plain between West and Mill rivers and the Quinnipiack river. Has large inland, coast and foreign commerce and extensive manufactories. Incorp, a city in 1784.

History.—Built in '60-2 by New Haven Water Co. Engr., Julius W. Adams, New York City, who was succeeded in '61 by Thos. N. Doughty as Const. Engr.

Water Supply.—Mill river, Maltby and Wintergreen lakes, by gravity and pumping to reservoir. The gravity works were purchased from the Fair Haven Water Co. in '76, the former village of Fair Haven now being a part of this city. Mill river has a drainage area of 56 sq. m and is dammed at a narrow gorge 2 miles from city, thus forming a reservoir 25 miles long with an average depth of 20 ft.

Dam.—Of heavy masonry, 500 ft. long, 38.5 high, from 3 to 6 ft. wide on top, and 27.5 wide at bottom; is backed with 8 in. of concrete from rock foundation to water level, against which is a gravel embankment 20 ft. wide at top and 100 at bottom in deepest part of river. An overfall 150 ft. long is constructed at each end. From chamber near west wing a 48-in. wrought iron pipe, 13 ft. below surface, conducts water for power and supply to pump-house.

Pumping Machinery.—Combined dy. cap., 15,000,000 galls. Two pumps of 16-in. diam. and 60 in. stroke are driven by two 30-ft. back pitch overshot wheels, each with 30 buckets, 6 ft. long. There is also a Worthington pumping engine.

Force Main.—From pump to reservoir on Sachem hill, originally 3,100 ft. of 16-in. cast-iron pipe. Connection can be made with distributing system, thus giving direct pressure.

Reservoirs.—One of 10,000,000 and one of 7,000,000 galls. cap. The Sachem hill reservoir is 129 ft. above tide water, in excavation and embankment; it is elliptical in shape with axes of 244 and 488 ft. at water line and depth of 19 ft.; bottom and slopes have 18 in. of puddle overlaid with 4 in. of concrete, and slopes have above this a 12-in. stone and cement wall. Reservoir is in two divisions.

Supply Mains.—Each 11,341 ft. long, the first one being of 16-in. cast-iron; two 12-in. mains have been added.

Distribution.—*Mains*, c. i., w. i. and cement, 119 miles. *Services*, galv. i. *Taps*, no record. *Meters*, 43. *Hydrants*, Bigelow, 685. *Valves*, Bigelow, Chapman.

Consumption, 8,800,000 galls. *Pressure*, Ordinary, 25 to 50 lbs. High service, 80 lbs.

Financial.—Cost, $1,564,000. Capital stock, $1,406,250. Bonded debt, $125,000. Int., 7%. Ann. op. exp., withheld. Ann. rev.: consumers, $178,607; city, $16,000 for all purposes, no separate allowance for hydrant rental.

Management.—Prest., Henry S. Dawson. Secy., Ellsworth I. Foote. Supt., S. E. Grannis.

NEW LONDON, *New London Co.* (Pop., 10,537; est., 13,000.) At mouth of Thames river, on good harbor. Engaged in commerce and manufacturing, and is a summer resort. Founded in 1646; incorp. a city in 1784.

History.—First and partially supplied in '02 by the Aqueduct Co., through logs from spring in northern part of city. In '40 the lower streets and wharves were supplied through cast-iron pipe from a mill pond in northern part of city, and also from a well near Wilson Manufacturing Co.'s works in center of city, the latter supply being pumped by above company. In '60 the 4-in. pipe from mill pond had become obstructed with rust and was replaced by a 6-in. wrought iron and cement ine which was in good order in '81. The 3-in. cast-iron pipe from the Wilson ks was also used as late as '81 in connection with the city works, under 140 ft

present works were built in '72 by city, when the population was about 9,6

Des. Engr., J. T. Fanning, now of Minneapolis, Minn. Const. Engr., W. H. Richards, the present Supt.

Water Supply.—Lake Konomoc, by gravity. The lake is about a mile from city, lying between wooded hills 180 ft. above tide-level and having a drainage area of 976 acres. The original lake had an area of 110 acres, but was raised 10 ft. by a dam 200 ft. below the outlet, thus increasing the area to 225 acres and giving a capacity of 600,000,000 galls.

Dam.—Between two sand hills, upon a thin stratum of hardpan which was underlaid by from 4 to 15 ft. of quicksand. The hardpan was covered with a layer of concrete upon which a cement masonry wall was built through the entire length of the dam, into the banks at either side and 1 ft. above high water mark. A row of sheet piling was driven near the upper edge of the dam and the filling in front of the masonry wall puddled and paved. The overfall is 25 ft. wide, of granite and cement. The dam has not leaked.

Gate-House.—Granite, on dam, with screens and gates for drawing water from different heights. Water is taken out through a 24-in. cast-iron pipe and there is also a 16-in. pipe outside the gate-house for use when making repairs.

Supply Main.—The first 6,800 ft. was of Scotch clay pipe, with wrought iron and cement sleeve joints, and was under a head of from 18 to 20 ft. The iron of the sleeves oxidized, causing leaks, but this was afterwards prevented by coating the shells with asphalt before lining with cement.

Distribution.—*Mains*, c. i., w. i. and cement, 25.8 miles. *Services*, w. i. and cement, lead; rubber-coated iron was first used, but this has been replaced with cement-lined. *Taps*, 1755. *Meters*, 40. *Hydrants*, Whittier, 136. *Valves*, Chapman, Ludlow.

Consumption, 1100,000 galls. *Pressure*: 34 to 55 lbs.

Financial.—Cost, $337,307. Debt, $250,000. Int., 7 %. Ann. op. exp., $21,587. Ann. rev.: consumers, $23,182; city, none.

Management.—Commrs. Prest., B. A. Armstrong. Supt., W. H. Richards.

NEW MILFORD, *Litchfield Co.* (Pop., 1,416; est., 1,500.) On Housatonic river, on succession of irregular terraces. Has some manufactories. Settled in 1707; incorp. a town in 1712.

History.—Built in '74 by New Milford Water Co., under a perpetual charter. Des. Engr., B. H. Hull, Bridgeport. Const. Engr., W. B. Stilson.

Water Supply.—Surface water, from mountain stream by gravity from a 15,000,000-gall. impounding reservoir, formed by dam 250 ft. long, 21 wide at bottom and 5 at top; cost of dam, $15,000.

Filter.—In reservoir, of brick, filled with sand, gravel and charcoal, through which water passes upward to open chamber, thence to 6-in. cast-iron supply main 1¼ miles long.

Distributing Reservoir.—Cap., 3,000,000 galls., is 250 ft. above reservoir.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. Pipe and specials furnished and pipe laid by J. H. & M. S. Austin, New Britain. *Taps*, 175. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 34. *Valves*, Peet.

Consumption, unknown. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $47,500. Capital stock, $25,000. No bonds. Debt, $12,000. Int., 5%. Ann. op. exp., $902. Ann. rev.: consumers, $4,066; city, $640. Hydrant rental, $20.

Management.—Prest., C. H. Booth. Treas., C. H. Noble. Supt., H. O. Warner.

NORWALK, *Fairfield Co.* (Pop., 5,308; est., 7,000.) Near mouth of Norwalk river, on Long Island Sound. Settled in 1640. Engaged in manufacturing.

History.—Built in '72 by borough. Des. Engr., Geo. H. Bailey. Const. Engr., J. F. Burgin.

Water Supply.—Silver mine stream, by gravity from impounding reservoir to distributing reservoir. Stream has a drainage area of about 20 sq. m. The first storage reservoir had a cap. of 60,000,000 galls. and was 292 ft. above tide-level. It was formed by a stone masonry dam with earth backing, 230 ft. long on top and 32 ft. high, 10 ft. being below bed of stream. In '83 a second dam of earth and stone masonry was constructed, 6 miles above the first, 125 ft. long, 30 ft. high, flooding 14 acres and storing 60,000,000 galls. Engr., Geo. W. Cram. Only one reservoir is reported as now in use.

Distributing Reservoir.—Cap., 4,500,000 galls.; connected with storage reservoir by 6 miles of 12-in. wrought iron and cement pipe; on Step hill 192 ft. above tideevel; is circular, 260 ft. in diam. at water surface, 16 ft. deep, constructed in excavation and embankment, with puddle wall in center, slopes 1½ to 1 and inner slope lined with riprap. Water is filtered through sponge in gate-house.

Distribution.—*Mains*, c. i., w. i. and cement, 25 miles. *Services*, w. i. and cement. *Taps*, 850. *Meters*, none. *Hydrants*, Mathews, 105. *Valves*, Ludlow.

Consumption, about 700,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $223,000. Debt, $175,000. Int., 4%. Ann. op. exp., $600. Ann. rev.: consumers, $10,200; city, none.

Management.—Water Board. Secy., A. H. Camp., Supt., Francis Leonard.

NORWICH, *New London Co.* (Pop., 15,112; est., 18,000.) At confluence of three small streams forming Thames river, and at head of navigation, 15 miles from Long Island Sound. Engaged in commerce and manufacturing.

History.—Built in '66-8 by city, when population was about 15,000. Engr., Jno. T. Fanning, now of Minneapolis, Minn.

Water Supply.—Surface water, by gravity from impounding reservoir having an elevation at overflow of 240 ft. above mean tide, an area of 66 acres, and a drainage area along the two streams impounded of 483 acres. Two filtering dams have been made at the inlet of tributary streams and the shores of the reservoir are protected to a depth of 4.5 ft. by a vertical dry stone wall 2.5 long.

Dam.—The reservoir is formed by an earth dam 25 ft. high, 468 ft. long, 25 ft. wide on top, with rubble masonry heart-wall through its center, and inner slope paved with stone. On the inner slope of the dam is a masonry gate-house in which is a 16-in. copper pipe with a flexible joint taking water from the reservoir at any depth and conveying it to the gate-chamber.

Distribution.—*Mains*, c. i., w. i. and cement, 34.8 miles. *Services*, lead. *Taps*, 4,327. *Meters*, 100. *Hydrants*, kind not given, 276.

Consumption, 1,230,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $506,212. Debt, $300,000. Int., 5 and 6%. Ann. op. exp., $13,000. Ann. rev.: consumers, $36,500; city, none, but an attempt is being made to obtain an allowance of $15 each for hydrant rental.

Management.—Fire Commrs. Prest., Dr, S. L. Geer. Secy., Jno. A. Morgan Supt., Junius A. Brand.

PLAINVILLE, *Hartford Co.* (Pop., 1.930; est., 2,000.) Is 14 miles west of Hartford. Manufactures clocks, carriages and woolen goods.

History.—Built in '84 by Plainville Water Co. Des. Engr., D. Goffe Phipps, Contrs., Connecticut Patent Water Pipe Co., and for dam, Chas. W. Blakeslee & Son, all of New Haven.

Water Supply.—Surface water, by gravity from reservoir of 63 acres area.

Distribution.—*Mains*, w. i. and cement, 6.5 miles. *Services*, galv. i. *Taps*, 127. *Meters*, none. *Hydrants*, kind not given, 23.

Consumption, 10,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Capital stock, $30,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $1,600; city, $400. Hydrant rental, $17.

Management.—Prest., Wm. S. L. Cowles. Secy., E. C. Chapman. Supt., H. W. Higgins.

PLANTSVILLE, *Hartford Co.* (Pop., not given.) A part of the Southington Water Co.'s Works, and all data included under Southington.

PUTNAM, *Windham Co.* (Pop., 5,827; est., 6,000.) On Quinnebaug river. Has a great variety of manufactories.

History.—Built by Putnam Water Co., under 20 year's charter. Engr., Wheeler & Parks, Boston, Mass.

Water Supply.—Little river, pumping to stand-pipe.

Pumping Machinery.—Worthington power pump, dy. cap., 1,000,000 galls.

Stand-Pipe.—Is 30 ft. in diam. and 45 ft. high.

Distribution.—*Mains*, c. i., 11 miles. *Services*, enam. w. i. *Taps*, 325. *Meters*, 7. *Hydrants*, Coffin, 61. *Valves*, Coffin.

Consumption, 100,000 galls. *Pressure*: Ordinary, 82 lbs. Fire, 82 lbs.

Financial.—Cost, $145,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 5%. Ann. rev.: city, $5,700. Hydrant rental, $40 each for 60. No further data given.

Management.—Prest., L. H. Fuller Putnam. Treas., E. Wheeler, 75 State St., Boston. Supt., C. D. Sharpe.

ROCKVILLE, *Tolland Co.* (Pop., 5,902: est., 6,800.) In Vernon township, 16 miles from Hartford. Manufactures envelopes, silk and woolen goods.

History.—Built in '67 by private company.

Water Supply.—Shenipsit lake, by gravity. Lake has an area of 524 acres, is 280 ft. above lowest part of town, and is impounded by a dam 51 ft. long and 18 ft. wide.

Distribution.—*Mains*, c. i. 8 miles; were originally wrought iron and cement, but proving unsatisfactory were changed. *Services*, lead. *Taps*, 500. *Meters*, none. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $60,000. Capital stock, $22,050. No debt. No charge for public hydrants. No further data given.

Management.—Prest., G. Maxwell. Secy. and Treas., J. C. Hammond, Jr. Supt., Chas. W. Wood.

SHARON, *Litchfield Co.* (Pop., 2,580; est., not given.)

History.—Being built in '88 by Sharon Water Co. Contr., Francis Leonard, Norwalk. Reservoir built by the company.

Water Supply.—Gravity system, source not given.

Distribution.—*Mains*, steel, lined with cement and coated with asphalt, made by Norwalk Water Pipe Co., Norwalk. *Hydrants*, Ludlow, 17.

Financial.—Cost, $12,500. Debt., $500.

Management.—Supt., I. N. Bartram.

SHELTON, *Fairfield Co.* (Pop., 1,362; est., 2,500.) A suburban borough of Birmingham. Not incorp.

History.—Built in '81 by Shelton Water Co. Engr., D. S. Brinsmade, Shelton.

Water Supply.—Curtis brook, by gravity from impounding and distributing reservoirs 1 mile apart, formed by dams across stream.

Reservoirs.—The first reservoir has a cap. of 50,000 galls., covers 18 acres and is formed by an earth dam, sheet-piled and puddled with clay. The second reservoir is formed by a masonry dam, covers ¾ acres, and is ½ mile from and 230 ft. above town.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, number withheld. *Meters*, 1. *Hydrants*, Mathews, 27. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $32,000, Capital stock, $25,000. No bonds. Debt, $7,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $3,000; city, $810. Hydrant rental, $30.

Management.—Prest., D. W. Plume. Secy. and Supt., D. S. Brinsmade.

SOUTHINGTON, *Hartford Co.* (Pop., 5,411; est., 6,000.) On Quinnipiac river, on rolling ground, in a valley between rocky hills. Manufactures carriages, tacks, wood screws, silver-plated ware, pocket cutlery and all sorts of hardware. Settled in 1690; incorp. a town in 1779.

History.—Built in '83-4 by Southington Water Co. Engr., T. H. McKenzie, Southington. Consulting Engr., J. J. R. Croes, New York City. Supplies Plantsville as a part of the system.

Water Supply.—Humiston's brook, by gravity from impounding and distributing reservoirs, ¾ miles apart. Brook is a mountain stream, with drainage area of about 2½ sq. m. and average daily flow in '83 of 4,300,000 galls.

Reservoirs and Dams.—Cap.: impounding, 60,000,000 galls.; distributing, 4,000,000 galls. First reservoir is formed by an earth dam, 525 ft. long, 16 ft. wide on top and 30 ft. high, having a stone masonry and puddle heart-wall and dry stone slope-walls, the inner slope being 2 to 1 and the outer 1½ to 1. Water is drawn from reservoir through 140 ft. of 20-in. cast-iron pipe, terminating in a stone masonry gate-tower. Distributing reservoir is 225 ft. lower, is formed by stone masonry dam 170 ft. long, 20 ft. high, 14 ft. thick at base and 5 ft. at level of overfall: is backed with earth at slope of 1½ to 1, and has an overfall 40 ft. long. There is a brick gate-house with waste and supply gates. Flow line is 213 ft. above public square and 230 ft. above most of town. A 10-in. cast-iron pipe, 2½ miles long, conveys water to town.

Distribution.—*Mains*, c. i., 12.3 miles. *Services*, galv. i. *Taps*, 350. *Meters*, none. *Hydrants*, Ludlow, 70. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure*: Ordinary, 98 lbs. Fire, 98 lbs.

Financial.—Cost, $93,300. Capital stock, $60,000. Bonded debt, $32,200. Int., 5%. Ann. op. exp., withheld. Ann. rev.: consumers, $5,150; city, $1,250. Hydrant rental, $17.85.

Management.—Prest., J. B. Savage. Secy., Treas. and Supt., T. H. McKenzie.

SOUTH NORWALK, *Fairfield Co.* (Pop., 3,726; est., 4,500.) On Long Island Sound at mouth of Norwalk river, on rolling ground. Engaged in oyster gathering and manufacturing.

History.—Built in '75 by town. Engr., Wm. B. Rider, South Norwalk.

Water Supply.—Surface water, by gravity from two impounding reservoirs on stream 5 miles from and 223 ft. above city, and having drainage area of 5 sq. m. Reservoirs are formed by earth dams with heart-walls of rubble masonry and cement, and have a combined capacity of 166,000,000 galls. At outlet water is filtered through charcoal and sponge and then conveyed to city through 4½ miles of 12-in. cast-iron pipe.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i., lead, brass. *Taps*, 451. *Meters*, 24. *Hydrants*, Mathews, 50. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $109,000. Bonded debt, $88,000. Int., 4 and 6%. Ann. op. exp., $787. Ann. rev.: consumers, $10,986; city $2,000. Hydrant rental, $40.

Management.—Commrs. Chairman, Saml. Raymond. Secy., Jacob M. Layton.

STAFFORD SPRINGS, *Tolland Co.* (Pop., 2,081; est., 3,000.) In Stafford township, on Willimantic river. Has woolen, cotton and iron manufactories.

History.—Built in '87 by Stafford Springs Water Co., under a perpetual charter. Engr. and Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Roaring brook, by gravity from storage and distributing reservoirs about 5 miles from and 285 ft. above village. Storage reservoir has cap. of 4,000,000 and distributing of 500,000 galls.

Distribuion.—*Mains*, 10 miles. *Taps*, 135. *Meters*, 30. *Hydrants*, 32.

Consumption, not given. *Pressure*: Ordinary, 128 lbs.

Financial.—Capital stock, $35,000. Bonds, $35,000. Hydrant rental, $30 for 30.

Management.—Prest., Wm. Birnie, Springfield. Secy., R. S. Hicks. Supt., Anthony Adams.

STAMFORD, *Fairfield Co.* (Pop., 11,297; est., 16,000.) On Long Island Sound on quite level ground. Has extensive manufactories.

History.—Built in '60 by Stamford Water Co. Des. Engr., H. G. Scofield, Bridgeport. Const. Engr., Geo. E. Whitney. Contrs., Cannecticut Patent Water Pipe Co., New Haven, and R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Trinity lake, by gravity to Simsbury reservoir. Lake is about 6 miles from village, in hills, and has a cap. of 300,000,000 galls. At its mouth is a small masonry dam, with gate-chamber and 16-in. outlet pipe.

Reservoir.—In excavation and embankment, 170 ft. above tide water; cap., 6,500,000 galls.

Distribution.—*Mains*, c. i., w. i. and cement, 33 miles. *Services*, lead. *Taps*, 1,088. *Meters*, 6. *Hydrants*, Ludlow, 93. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Capital stock, $200,000. Bonded dett. $70,000. No further financial data given.

Management.—Prest., Jas. B. Williams. V. Prest., A. T. Hatch. Treas., G. A. Hoyt. Supt., Geo. E. Whitney.

STONINGTON, *New London Co.* (Pop., 7,355; est., not given.) On Long Island Sound. Has good harbor and is engaged in trade and manufacturing.

History.—A small private gravity supply for railroad and steamboat use was introduced in '65, consisting of 4 miles of pipe, 12 taps and 9 hydrants.

In '88 the Mystic Valley Water Co. are putting in a system to supply the entire borough and also the Mystic fire district. Construction was begun about June 1 and is to be finished Jan. 1., '89. Engrs. and Contrs., Wheeler & Parks, Boston, Mass.

New System.—It is unofficially reported that the supply will be from Copp's brook, by pumping to a 2,000,000-gall. circular reservoir at an elevation of 185 ft., and that there will be 14 miles of pipe and 42 hydrants.

THOMASTON, *Litchfield Co.* (Pop., 3,225; est., 4,000.) On irregular ground, has rolling mills and manufactures clocks.

History.—Built in '80 by Thomaston Water Co. Engr., Wm. B. Rider, South Norwalk. Contr., C. T. Leonard & Son, South Norwalk.

Water Supply.—Springs, by gravity from impounding reservoir with an area of 11 acres.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 300. *Meters*, number not given. *Hydrants*, kind not given, 36.

Consumption, unknown. *Pressure*: Ordinary, 126 lbs. Fire, 126 lbs.

Financial.—Cost, $42,000. Capital stock, $36,000. No bonds. Debt, $1,500. Int., 5 %. Ann. op. exp., $387. Ann. rev.: consumers, $2,920; city, $600. Hydrant rental, $16.66.

Management.—Prest, Aaron Thomas. Secy., W. T. Woodruff. Treas, A. J. Hine. Supt., Nelson Bennett.

THOMPSONVILLE, *Hartford Co.* (Pop., 3,794; est. 4,000.) On Connecticut river. Engaged in carpet and other manufacturing.

History.—Built in '85 by Thompsonville Water Co. Engrs. and Contrs., Goodhue and Birnie, Springfield, Mass., who control the works.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.— Deane, dy. cap., 1,000,000 galls,

Tank.—Is 40 ft. in diam. and 25 ft. high.

Distribution.—*Mains*, w. i. and cement, 10 miles. *Services*, w. i. and cement. *Taps*, 550. *Meters*, none. *Hydrants*, 20.

Consumption, 300,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000. Capital stock, $50,000. No debt. Ann. rev.: total $5,600. Hydrant rental, $50.

Management.—Prest., Chas. H. Briscoe. Treas., Wm. Birnie. Clerk, Thos. N. Birnie: the latter two of Springfield, Mass.

TORRINGTON, *Litchfield Co.* (Pop., 3,327: est., 3,900.) On Naugatuck river, in broken and rocky country. Has some manufactories.

History.—Built in '78 by Torrington Water Co., Engr., Wm. B. Rider, South Norwalk.

Water Supply.—Surface water, by gravity from impounding reservoirs on stream, having drainage area of 8 sq. m.

Reservoirs.—First reservoir built has an area of 5½ acres and cap. of 18,000,000 galls. and is formed by earth dam 234 ft. long and 20 ft. high, with masonry heart-wall 8 ft. wide at bottom and 3 ft. at top. Second reservoir has area of 19¼ acres and cap. of 53,000,000 galls.

Filter.—Before entering distribution pipes water passes through charcoal, then through sponge, with good results.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i. *Taps*, 390. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, 6,500, city, $360. Hydrant rental. $15.

Management.—Prest., I. W. Brooks. Secy. and Treas., C. L. McNeil. Supt., O R. Fyler.

WALLINGFORD, *New Haven Co.* (Pop., 3,017; est., 5,000.) On hilly ground. on Quinnipiac river. Engaged in manufacturing. Incorp. a borough in '68.

History.—Built in '82 by borough. Des. Engr., D. C. Sanford. Const. Engr., Jno. Osborne. Contr., Wm. C. McClallan, Chicopee, Mass.

Water Supply.—Lake Pistapang, by gravity. Lake is 4½ miles from and 245 ft. above center of borough, and 315 to 330 ft. above manufacturing portions. It has an area of 136 acres, a drainage area of about ½ sq. m., and the drainage of an additional ¾ sq. m. can be diverted into the lake. Water is taken 800 ft. from shore, at a depth of 11 ft., through an 18-in. stoneware pipe to gate-chamber, from which a cast-iron pipe of 12 in., afterwards reduced to 10 and 8 in., leads to borough; 1,000 ft. of the distance being through a tunnel 30 ft. below the surface.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i. *Taps*, 600. *Meters*, 2. *Hydrants*, Chapman, 69.

Consumption, 151,000 galls. *Pressure*: 100 to 130 lbs.

Financial.—Cost, $104,000. Bonded debt, $105,000. Int., 4%. Ann. op. exp., $348. Ann. rev.: total, $6,000. Hydrant rental, $15.

Management.—Commrs. Supt., Wm. M. Hall.

WATERBURY, *New Haven Co.* (Pop., 17,806: est., 30,000.) On Connecticut river, surrounded by hills. Has extensive manufactories of all kinds of brass goods. Settled in 1667; incorp. a city in '53.

History.—Built in '68 by city. Const. Engr., Nelson J. Welton.

Water Supply.—Surface water, by gravity from springs and brook on East Mountain; also emergency supply by pumping from Mad river.

Reservoirs.—Have a combined area of about 60 acres and cap. of 180,000,000 galls. First two were built on East Mountain brook, with dams of sand and gravel founded on rock, having puddle walls in center. The upper dam was 30 ft. high, 360 ft. long, and its slopes were lined with scrap tin to prevent damage by muskrats. This formed a 1,000,000-gall. reservoir. The lower dam was 25 ft. high, 265 ft. long, and formed an 8,000,000-galls. reservoir ¾ miles from and 175 ft. below the upper reservoir, and 225 ft. above town. In '80 a new storage reservoir was built on another stream and connected with the upper reservoir by 3,500 ft. of 12-in. pipe. There is a high service reservoir at Cooke street, which can be used for general distribution in case of accident to the other reservoirs, or to supply mains.

Supply Main.—About 2 miles from East Mountain reservoir to village; originally of 12-in. cement pipe. In '87 all but the first 1,500 ft. was replaced with 3,486 ft. of 16-in. and 5,600 ft. of 18-in. cast-iron pipe and it is proposed to replace the remaining 1,500 ft. of cement pipe with 16-in. cast-iron. The above change increased the average pressure in the city by 20 lbs. The new pipe was furnished by the Warren Foundry & Machine Co., Phillipsburg, N. J

Distribution.—*Mains*, c. i., w. i. and cement, 31.3 miles. *Services*, galv. i. *Taps*, 3,000. *Meters*, 128; 73 Union rotary, 31 Crown, 18 Worthington, 4 Ball & Fitts piston, 1 Hartford, 1 Special. *Hydrants*, Holyoke, 236. *Gates*, 298. Edson pressure-recording gauge used.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—Cost, $173,885. Bonded debt, $265,000. Int., 4½%. Sinking fund, $57,150. Ann. op. exp., $10,009. Ann. rev.: consumers, $44,643; city, $4,095. Hydrant rental, $20.

Management.—Five Commrs. Prest. and Supt., Nelson J. Welton. Engrs. to Board, Welton & Bonnett.

NOTE:—Surveys have been made for the location of a new 400,000,000-gall. reservoir on Hop brook, in Watertown, 5 miles from and 325 ft. above Center square. This would involve a dam 600 ft. long, 35 ft. high, containing 40,000 cu. yds. of masonry and earthwork, and a pipe line to city, 26,500 ft. long, in three nearly equal sections, having 20, 18 and 16-in. pipe, according to grade. The estimated cost of dam and pipe is $180,000, not including land or right of way. A survey with reference to connecting Quassapaug lake with proposed reservoir shows the distance between them to be about 8,000 ft. and that the high-water mark in the lake is 87.65 ft. above flow-line of reservoir. By laying 4,000 ft. of pipe from the lake water could be discharged into Hop brook and thence to reservoir; 30-in. pipe is recommended. The proposed reservoir with lake connection would ensure a future ample supply.

WEST HAVEN, *New Haven Co.* (Pop., 1,975: est., 4,000.) A borough in township of Orange, 2 miles from New Haven. Has numerous manufactories.

History.—Built in '83 by West Haven Water Co. Engr., D. Goffe Phipps, New Haven. Contrs., Connecticut Patent Water Pipe Co., New Haven.

Water Supply.—Cove river, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., 500,000 galls.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, Conn. Patent Water Pipe, 8½ miles. *Services*, galv. i. *Taps*, 311. *Meters*, 7. *Hydrants*, Ludlow, 5. *Valves*, 5.

Consumption, unknown. *Pressure*: Ordinary, 43 lbs. Fire, 43 lbs.

Financial.—Cost, $56,000. Capital stock, $100,000. Further financial data withheld.

Management.—Prest., D. Goffe Phipps, 78 Crown St., New Haven. Supt., E. H. Phipps.

WILLIMANTIC, *Windham Co.* (Pop., 6,608: est., 10,000. In Windham township, on Willimantic river. Manufactures silk, cotton, and other goods.

History.—Built in '85-6 by city. Engr., J. T. Fanning, Minneapolis, Minn.

Water Supply.—River Natchaug, pumping to reservoir.

Pumping Machinery.—Made by R. D. Wood & Co., Philadelphia, Pa; cap., 1,500,000 galls.

Reservoir.—Cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, 686. *Meters*, 35. *Hydrants*, R. D. Wood & Co.'s, 134.

Consumption, 350,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $230,000. Bonded debt, $200,000. Int., 4%. Ann. op. exp., $10,500 Ann. rev.: consumers, $5,500; city, $4,360. Hydrant rental, $30.

Management.—Three Commrs. Prest., S. C. Smith. Secy., A. R. Morrison. Supt., H. S. Moulton.

WINSTED, *Litchfield Co.* (Pop., 4.279; est., 6,000.) Consists of two villages on Mad river, connected by a winding street, 3 miles long, on which is business portion of town, residences being on hillside further back. Settled in 1770.

History.—Built in '62 by borough. Engr., A. Chamberlain.

Water Supply.—From lake by gravity. Lake is about 1 mile wide and 3 miles long. The original supply was from two natural ponds, one of 390 acres area, increased to 500 acres by earth dam 4 ft. high, and one of 100 acres area. In '74, two waste-weirs of masonry, with concrete overflows, were built. Supply was taken from lake about ½ mile from and 220 ft. above town.

Distribution.—*Mains*, c. i., w. i. and cement, 11 miles. *Services*, galv. i. *Taps*, 744. *Meters*, none. *Hydrants*, Holyoke, partly, 96.

Consumption, unknown. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $116,167. Bonded debt, $25,000. Int., 4 and 5 %. Ann. op. exp., $1,070. Ann. rev.: consumers, $6,167; city, none.

Management.—Three Commrs. Supt. E. E. Culver.

Water-Works Projected with Fair Prospects of Construction.

EAST HARTFORD, *Hartford Co.* (Pop., 3,500; est., 4.000.) Manufactures paper and carriages.

Proposed System.—The East Hartford Water Co. was chartered in '87, but has not yet organized, as sufficient capital has not been secured and all plans yet proposed require a considerable outlay. Report made by E. J. McKnight.

NEWTON, *Fairfield Co.* (Pop., 4,013; est., not given.

Proposed System.—Surveys have been made and estimates furnished by Hull & Palmer, Bridgeport, a private company proposing to build works. The only available supply is Saunten lake, and as parties claim damages if this supply is used it is necessary to obtain a special charter from the Legislature to take water from the lake.

PORTLAND, *Middlesex Co.* (Pop., 4,167; est., 4,500.) Is 14 miles from Hartford. Has quarries of red stone.

Proposed System.—A charter has been granted to the Portland Water Co. and the town has voted to take hydrants. Company has not yet organized and wishes to let reliable parties take the charter and construct a gravity system, taking the supply from a mountain brook. Report by A. Gildersleeve, of Gildersleeve.

Present Supply.—Wells and cisterns. Town Clerk, W. H. Bartlett.

Water-Works Projects Reported in '87-8, but now Indefinite.

WINDSOR LOCKS, *Hartford Co.*

GROUP 2.--Middle States.--Water-Works Completed, in Process of construction or Projected, in New York, New Jersey, Pennsylvania, Delaware, Maryland and District of Columbia.

NEW YORK.

Water-Works Completed or in Process of Construction.

ADAMS, *Jefferson Co.* (Pop., 1,250; est., 1,500.) In farming country, and has several manufactories.

History.—Built in '86 by Adams Water-Works Co. and controlled by Moffett, Hodgkins & Clarke, Watertown, who were the Engrs. and Contrs.

Water Supply.—Springs, pumping to stand-pipe with direct pumping in case of fire.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls.

Stand-Pipe.—Wrought iron 15 ft. in diam. by 40 ft. high: has cap. of 55,000 galls., and is on elevation 160 ft. above business part of town.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. iron. *Taps*, 42. *Meters*, 1. *Hydrants*, Eddy, 21.

Consumption, 45,000 galls. *Pressure*: Ordinary, 44 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6 %. Ann. rev.: city, $1,070. No further financial data given.

Management.—Supt. I. W. Payne.

ALBANY, *Albany Co.* (Pop., 90,758; est., 94,000.) On Hudson river, extending for a few hundred feet from river over an alluvial plain, then rising quite abruptly to a plateau 150 to 220 ft. high. The slope towards the river is divided by three or four valleys worn by former streams in the clay bluff. Settled in 1616; incorp. a city in 1686.

History.—Gravity works built in '13 by city and in '30 by company; new gravity works built by city in '51, were reinforced by pumping in '72 and supplemented by pumping from Hudson river in '73; new system by pumping from driven wells is being constructed in '88.

The first supply, in '13, was introduced when the population was 11,000. Water was brought to the city from small streams through 3 miles of 6-in. cast-iron pipe. Three tons of pipe were laid, some of which is still in use after a longer service than is recorded of any other cast-iron pipe in the United States, and it claimed that this was the first cast-iron pipe made in the country. Two straight pieces and one branch of this pipe are in the possession of the American Society of Civil Engineers, New York City.

In '30, the population being 24,000, a company was formed for supplying water from Maezlandt Kill, Middle and Patroon creeks, a dam being built across each. On the former stream a second reservoir was built and housed in and water brought to it by a wooden flume, 3 ft. sq.; from here it was conducted to the city by a small brick conduit and by a 20-in. cast-iron pipe, connection being made with the two other streams by small square brick conduits. The distribution was by cast-iron pipes and wooden logs from a small reservoir on Eagle street.

In '51, the population being about 50,000, works were built by the city. Engr., Wm. J. McAlpine, New Brighton. In '73 the plan to take water from Hudson river was adopted. Engr., I. C. Chesbrough. Consulting Engr., Prof. C. F. Chandler, and Jas. P. Kirkwood, deceased.

Water Supply.—By gravity from Patroon creek and the works built by the company in '30, by pumping to reservoir from impounding reservoir at Tivoli Falls, and by pumping from Hudson river. A new supply from driven wells will soon be introduced.

The supply taken from Patroon creek in '51 was first impounded in a reservoir called Rensselaer Lake, then conveyed to a distribution reservoir on Bleecker hill. The impounding reservoir below Tivoli Falls was at first connected with the old reservoir built in '30 on Eagle street and supplied the lower districts. In '73, the timber having been cut from the drainage area of the creek, the lake having been partially filled by sand driven into it during storms, and the population having increased, the supply was insufficient and of bad quality. A 1,000,000-gall. Worthington pump was then erected and water pumped from Tivoli Lake into the Bleecker reservoir, and in the following year a second pump forced water into Rensselaer Lake.

In '73 the supply was further increased by pumping from Hudson river to Bleecker reservoir, and in '75 a high service reservoir was built on Prospect hill and supplied by pumping from the Bleecker reservoir.

The new driven well supply will furnish at least 15,000,000 galls. daily. The last of September, '88, there had been driven 225 of these wells, each 2 in. in diam., located along 5 lines of pipe connecting with a receiving tank. Each well is connected, with the main by a 3-in. pipe, the mains are 16, 18 and 20-in. in diam., and the tank 12ft. in diam. by 12 ft. deep. On the pipe leading from each well there is a 3-in. Eddy valve. The temperature of the water is 48°, which is said to be lowest attained from driven wells. Water will be pumped from the receiving tank to three reservoirs. The wells are being put in by Wm. D. Andrews & Bro., Brooklyn, under their patents, and the reservoir by Crawford & Valentine, Brooklyn. The Engr. for the reservoirs and their connection with the wells is J. M. de Varona, Brooklyn.

Reservoirs.—*Rennselaer Lake*: Formed by an earth dam 34 ft. high, carried 8 ft. above water-line, 10 ft. wide at top, with outside slope 2 to 1, and inside slope 1½ to 1, having clay puddle lining covered with coarse sand. Area of lake, 30 acres; cap., 160,000 000 galls. *Conduit*: Connecting above lake with Bleecker reservoir, 21,000 ft. long; brick, 8 in. thick; oval, 3½ by 4 ft.; had grade of 1 ft. to the mile and dy. cap. of 600,000 galls. The conduit was built in an embankment having foundations 42 ft. wide, slope of 2½ to 1, top of bank 6 ft. wide and 9 ft. above grade line. After being in use a short time the conduit settled throughout its length and cracks from 50 to 200 ft. long admitted quicksand and water, washing out the mortar in the arch. At other places large holes in the bottom allowed heavy leakage. The conduit was repaired and continued in use. *Bleecker hill distributing reservoir*: In excavation and embankment, 500 by 570 ft.; cap., 20,00,000 galls; inside slopes were first puddled and covered with flagging stones, but in '76 the latter were replaced by paving blocks and cement. *Tivoli reservoir*: Has earth dam 25 ft. high, an area of 20 acres and a cap. of 30,000,000 galls. *Prospect hill high service reservoir*: Cap., 6,743,378 galls.; has area of 1¾ acres and depth of 14 ft.; has banks of sand, rolled in layers and covered with soil and sodded; inner slopes 1½ to 1, outer, 2 to 1. The bottom has 6 in. of puddle lining, then 6 in. of concrete, then 18 in. of puddle and finally a covering of brick and cement. For 10 ft. from bottom inner slopes have a 6-in. layer of puddle and concrete, then 2½ ft. of puddle and 10 ins. of brick and cement; from this point to 5 ft. above water-line is a paving of stone and cement, backed by 3 ft. of gravel placed on 3 ft. of puddle and concrete.

Pumping Machinery.—Combined cap., 12,000,000 galls. For the high service, water was taken from Bleecker reservoir through 1,390 ft. of 24-in. pipe to a pump-well and from there lifted 55 ft through 420 ft. of pipe to Prospect hill reservoir by a pair of compound condensing beam engines, connected to one fly-wheel, each engine operating one Thames Ditton pump. The supply from Hudson river was lifted from pump well to Bleecker reservoir, 249 ft., through 9,723 ft. of 30 in. pipe by a pair of compound condensing beam engines, connected with one fly-wheel.

Inlet Shaft and Tunnel.—The pump-well at Hudson river is 870 ft. from the inlet shaft and connected with it by a tunnel. In building the inlet shaft, a brick shaft 10 ft. inside diam. and 47 ft. deep, was secured to a cast-iron shoe by vertical tie rods, and sunk on the pier between the river and the Erie Canal basin. This shaft cracking, a second, 7½ ft. inside diam., was built within it and sunk 4 ft. further, or to a total depth of 51 ft., about to bed rock, where the existing work was made fast by cast-iron cylinders, and the latter sunk to make a total depth for the shaft of 80 ft, From this point a horizontal drift, 6 ft. in diam., was driven through the rock, 220 ft. The part of the tunnel from the pump-well to the Erie Canal basin was already completed, being mostly through hard-pan gravel, bricked. This was connected with the first 220 ft. from the river by a drift descending 2½ to 1.

Distribution.—*Mains*, c. i., 90.65 miles. *Services*, lead. *Taps*, 14,246. *Meters*, 52. *Hydrants*, Philadelphia, 575, about adopting another kind.

Consumption, unknown. *Pressure*: not given, reservoirs are 145, 425 and 300 ft. above tide-level.

Financial.—Cost. not given. Debt, $1,089,000. Int., 4, 6 and 7%. Ann. rev.: consumers, (in '85) $162,000. More completed data can be given when the new system is in operation.

Management.—Five Commrs. Prest., R. Lenox Banks. Supt., G. W. Carpenter. Pumping Engr., Jno. H. Mars.

ALBION, *Orleans Co.* (Pop., 5,137; est., 5,200.) Has several mills and manufactories.

History.—To be put in operation Oct. 1, '88; owned by Albion Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo. Sub-Contrs. for masonry, Ward S. Buell, Albion.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Two compound duplex Volker & Felthousen pumps, dy. cap., 2,000,000 galls.

Stand-Pipe.—Cap., 250,000 galls.; made by Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Hydrants*, Ludlow, 80. *Valves*, Ludlow.

Financial.—Capital stock, $100,000. Ann. rev.: city, $3,000. Hydrant rental, $37.50.

Management.—Prest., Geo. M. Wood. Secy., E. M. Bassett, Buffalo. Supt., F. T. Clark.

NOTE:—Further data could not be given as works were just being put in operation at time of report.

AMSTERDAM, *Montgomery Co.* (Pop., 9,466; est., 17,000.) On Mohawk river. Manufactures knit goods, carpets and steel springs.

History.—Built in '82 by city. Engr. Stephen E. Babcock, Little Falls.

Conduits.—The water from several streams is conveyed to the reservoir through salt-glazed, vitrified pipe.

Water Supply.—Surface water, by gravity, there being a 90,000,000-gall. reservoir.

Distribution.—*Mains*, c. i., 15.11 miles. *Services*, lead. *Taps*, 1,314. *Meters*, 43. *Hydrants*, Ludlow, 140. *Valves*, Ludlow. *Pressure gauge*, Edson.

Consumption, 165,792 galls. *Pressure*: Ordinary, 80 lbs. Fire, 133 lbs.

Financial.—Cost, 271,221. Debt, $257,000. Int., 5%. Ann. op. exp., $3,500. Ann. rev: consumers, $23,000. Hydrant rental, free.

Management.—Prest., Jas. R. Snell. Supt., A. H. DeGraff.

NOTE:—A further description of these works, especially the conduit, is given in *Eng. News*, vol. xix., p. 331, in a paper read by the engineer, Mr. Babcock, at the Cleveland Convention of the American Water-Works Association, Apr. 17, 1888. Contracts for extensions have been let in '88. For cast-iron pipe and specials, Chas. Millar & Sons, Utica; pipe laying, Adam Miller; Mohawk river crossing, T. Sullivan. & Co., Syracuse; valves and hydrants, Ludlow Valve Mfg. Co., Troy.

ANDES, *Delaware Co.* (Pop., 496; est., 500.) In farming district.

History.—Built in '76 by Andes Water Co.

Water Supply.—Spring, by gravity.

Reservoir.—Is 35 ft. in diam. and 8 ft. deep.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, lead *Taps*, (in '86) 60. *Meters*, none. *Hydrants*, kind not given, 26.

Consumption, not given. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $6,000. Int., 6 or 7%. No further financial data given.

Management.—Prest., Duncan Ballantine. Supt., David Ballantine.

ATTICA, *Wyoming Co.* (Pop., 1,935; est., 3,000.) On Tonawanda River.

History.—Built in '79 by Attica Water Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 12,000,000 galls.

Distribution.—*Mains*, c. i., 3.5 miles. *Services*, w. i. *Taps*, 100. *Meters*, 1. *Hydrants*, Mathews, 26. *Valves*, Eddy, mostly.

Consumption, 225,000 galls., about one-half of which is used by Erie R. R. Co. *Pressure*: Ordinary, 62 lbs. Fire, 62 lbs.

Financial.—Cost, $76,000. Debt, 40,000. Int., 6%. Ann. op. exp., $500. Ann rev.: consumers, $4,500; city, $1,050. Hydrant rental, $35, contract for five years.

Management.—Prest., Chas. E. Loomis. Secy. and Supt., Geo. T. Loomis.

AUBURN, *Cayuga Co.* (Pop., 21,924; est., 26,000.) On high, uneven ground at outlet of Owasco lake, a stream flowing through town and furnishing a valuable water-power. Manufactures boots and shoes, carpets, woolen and iron goods, agricultural implements, including mowers and reapers. Settled in 1793; incorp. a city in '48.

History.—Built in '65 by Auburn Water-Works Co., when population was about 14,000.

Water Supply.—Owasco lake, by direct pumping from impounding reservoir on outlet of lake. Lake is about 1 by 12 miles, having a drainage area, including the lake, of 156 sq. m.

Dam.—Reservoir formed by masonry dam, 14 ft. high, built jointly by water company and State of N. Y., the outlet being used, when necessary, as a feeder to Erie canal.

Pumping Machinery.—Combined dy. cap., 14,000 galls.: one 6,000,000 and one 8,000,000-gall. Holly pump.

Formerly two rotary pumps were driven by two turbine wheels. These were replaced by three turbine wheels of 5, 5½ and 7 ft. diam., the smaller wheel driving a gang of 6 vertical pumps of 14-in. diam. and 12-in. stroke, and dy. cap. of 1,500,000 galls., and the two larger wheels driving one 4-cylinder pump of 14-in. diam., and 17-in. stroke, with a dy. cap. at 30 revolutions of 6,000,000 galls., and two rotary pumps, with a dy. cap. of 2,000,000 galls. each. For reserve, there was a 200 H. P. Holly steam engine, geared to run any or all pumps. In later years the water-power became so small that the steam engine was used from 3 to 6 months in the year.

Distribution.—*Mains*, c. i., 32 miles. *Services*, w. i. *Taps*, withheld, *Meters*, 400. *Hydrants*, Mathews, 331.

Consumption, 2,000,000 galls., reduced by meters from 2,500,000. *Pressure*: Ordinary, 50 lbs. Fire, 80 to 150 lbs.

Financial.—Cost, $400,000. Ann. rev.: city, $16,500. Hydrant rental, $50.

Management.—Prest., A. G. Beardsley. Supt., Secy. and Treas., N. B. Eldred.

AVERNE-BY-THE-SEA, *Queens Co.* See Far Rockaway.

AVON, *Livingston Co.* (Pop., 1,617; est., 2,000.) A summer watering place on Genesee, on a terrace 100 ft. above river.

History.—The first works were built in '57 by a private company after plans by McRee Swift. In '85 the Co. had 7 miles of pipe, 200 taps and 9 hydrants. The supply was from springs, by gravity. New system being built in '88 by village. Engr., E. D. Smalley, Canastota. Contr. for masonry, reservoir and pipe laying, Brown & Doyle, Mohawk.

Water Supply.—Conesus lake, by gravity to distributing reservoir.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, rustless i. *Hydrants*, 32. Pipe, specials and hydrants furnished by Jas. J. Dwyer, Utica. *Pressure*: Ordinary, 75 to 110 lbs.

Financial.—Cost, $50,000. Bonded debt, $50,000. Int., 3.7%.

Management.—Prest., G. D. Dover. Secy., Orange Sackett. Treas., P. C. Gleason. No Supt.

No further data given, as works were not completed at time of report.

BAINBRIDGE, *Chenango Co.* (Pop., 781; est., 1,000.) On Susquehanna river on undulating ground. Has some manufactories.

History.—Built in '83 by J. N. Roberts.

Water Supply.—Artesian wells, springs and reservoirs, by gravity.

Reservoirs.—One covering 15 acres, and one 50 by 120 ft., by 16 ft. deep.

Distribution.—*Mains*, w. i., 6 miles. *Services*, w. i., lead. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, not given. *Pressure*: Ordinary, 115 lbs. Fire, 115 lbs.

Financial.—Cost, $19,000. Debt, $10,000. Int., 6%. Ann. op. exp., $200. Ann. rev.: consumers, $2,000; city, $400.

Management.—Owner and Supt., J. M. Roberts.

BALLSTON SPA, *Saratoga Co.* (Pop., 3,011; est., 4,500.) A summer resort, 7 miles from Saratoga Springs. Engaged in manufacturing.

History.—Built in '70 by village and under their direction.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, w. i. and cement, 11 miles. *Services*, w. i. and cement. *Taps*, 400. *Meters*, 2. *Hydrants*, Eddy, Bailey, 100. *Valves*, Eddy, Bailey.

Consumption, 600,000 galls. *Pressure*: Ordinary, 36 lbs. Fire, 36 lbs.

Financial.—Cost, $100,000. Bonded debt, $50,000. Int., 5 to 7%. Ann. op. exp., $150. Ann. rev.: consumers, $4,500; city, none.

Management.—Village Trustees. Supt., Jas. H. Norris.

BATAVIA, *Genesee Co.* (Pop., 4,845; est., 8,000.) On Tonawanda creek, in a slightly undulating country. Engaged in manufacturing agricultural implements, wheels and lumber goods. Settled in '03.

History.—Built in '65 by village.

Water Supply.—Tonawanda creek, pumping to tank and direct pumping in case of fire.

Pumping Machinery.—Holly and Gaskill pumps, dy. cap. not given.

Tank.—Wooden, 40 ft. high, on stone foundation, and has cap. of about 22,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 60.

Consumption, 500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 125 lbs.

Financial.—Cost, $115,000. Debt, $45,000. Int., 3%. Ann. rev.: city, $1,300. No further financial data given.

Management.—Water Board. Prest., W. C. Woolsey. Clerk, Geo. Perrin.

BATH, *Steuben Co.* (Pop., 3,183; est., 5,000.) Has some manufactories.

History.—Built in '87 by Bath Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Wells and springs, pumping to stand-pipe.

Pumping Machinery—Blake pump, dy. cap., 1,500,000 galls.

Stand Pipe.—Cap., 305,000 galls.; made by Farrar & Trefts.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. Pipe and specials furnished by Buffalo Cast Iron Pipe Co., Buffalo. *Taps*, 70. *Meters*, 12, at time of report. *Hydrants*, Ludlow, 71. *Valves*, Ludlow.

Consumption, not known at time of report. *Pressure*: Ordinary, 80 lbs. Fire, 124 lbs.

Financial.—Cost, $100,000. Capital stock, $72,000. Debt, $60,000. Int., 6%. Ann. rev.: city, $2,400. Hydrant rental, $33.80. No further data known at time of report.

Management.—Prest., F. A. Hinds. Secy., E. M. Bassett. Treas., S. F. Bagg. Supt., Chas. Van Wie.

BATH BEACH, *Kings Co.* See Gravesend.

BATH-ON-THE-HUDSON, *Rennselaer Co.* (Pop., 2,046; est., 4,000.) In township of North Greenbush, on Hudson river, opposite Albany. Engaged in handling coal and ice.

History.—Supplied in '88 from works of Greenbush company. Engr. and Contrs., Moffett, Hodgkins & Clarke, Watertown, who control works.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 52. *Meters*, none, *Hydrants*, 49.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 160 lbs.

Financial.—Ann. rev.: city $1,300.

Management.—Supt., Jno. Winn.

NOTE:—Other data included under Greenbush.

BAY RIDGE, *Kings Co.* See Gravesend.

BINGHAMPTON, *Broome Co.* (Pop., 17,317; est., 25,500.) On a nearly level plain at junction of Chenango and Susquehanna rivers. Has good water-power, many manufactories and a large trade. Settled in 1787; incorp. a city in '67.

History.—Built in '67-8 by city. Const. Engr., Jno. Evans.

Water Supply.—Dug wells and Susquehanna river, direct pumping. Wells are near the river.

Pumping Machinery.—Two Holly, quadruple, four cylinder, compound condensing pumping engines, with dy. cap. of 2,000,000 and 6,000,000 galls.

Distribution.—*Mains*, c. i., w. i. and cement, 29 miles. *Services*, w. i., lead, galv. i. *Taps*, 3,536. *Meters*, 203. *Hydrants*, Mathews, 257. *Valves*, Eddy. *Pressure gauge*, Edson.

Consumption, 2,515,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 65 lbs.

Financial.—Cost, $221,000. Debt, $179,000. Int., 3½ and 7 %, the latter being on $25,000 only. Ann. op. exp., $12,227. Ann. rev.: consumers, $40,000; city, none.

Management.—Commrs. Secy., H. E. Allen. Supt., D. Felter.

BROOKLYN, *Kings Co.* (Pop., 566,663; est., 770,000.) Opposite New York City, on west end of Long Island. The elevation of the city varies from about tide-level to 60, 80 and 120 ft., in various parts, and is 200 ft. at Prospect Park.

History.—Built in '56-9 by city. In '55 population was 205,250, supplied entirely from wells. Des. Engr., Saml. McElroy. The Nassau Water Co. was formed to construct the works and let the contract for $4,025,000, but before work was begun city took up the stock, appointed five commissioners to supervise the work, with Jas. P. Kirkwood, Chf. Engr., and S. McElroy and Moses Lane, Asst. Engrs. Afterwards the management was vested in the Nassau Water Board, of three members appointed by the Mayor and Aldermen, and in '74 it was transferred to a Board of City Works. Since Mr. Kirkwood, the Chf. Engrs. have been Moses Lane, Julius W. Adams and Robert Van Buren, who still holds the office.

Water Supply.—Surface water, open wells, and Andrew Bros. system of driven wells, by pumping to reservoirs. There are three open wells, 50 ft. in diam., and four stations with driven wells. The whole supply is drawn from the sandy southern slope of Long Island, from a drainage area of 74 sq. m.

The original supply was conveyed to a pumping station by a conduit connecting with several of the ponds, and forced thence to the Ridgewood distributing reservoir. From the mains leading from this reservoir water is now pumped to a high service reservoir on Mount Prospect. Later, other ponds were brought into service, but as these were below the conduit, pumping stations were built at each. Since '83, Wm. D. Andrews & Bro. have put in driven wells, making four additional stations from which water is pumped to conduit.

Conduit.—All water either passes by gravity, or is pumped, into conduit, and goes to Ridgewood pumping station, where it is lifted to the Ridgewood reservoir. Conduit is of masonry, underground, with gradient of 0.5 ft. per mile, to pump-well 7 miles from East river. From pump-well to first pond, 4¾ miles, conduit has base 15 ft. wide, on which rest rubble stone masonry walls, surmounted with semicircular brick arch. Bottom and sides are lined with 4 in. of brick. Bottom is segmental arch of 9.75 chord and 0.67 versed sine. From 2 ft. above spring of invert side walls are 10 ft. apart and the arch is 1 ft. thick. Beyond first pond the sectional area of conduit is diminished in proportion to amount of water to be carried. At pump-well conduit is 1.75 ft. above tide-level.

Pump-Well.—Rectangular, chamber, with granite walls and bottom, 10 by 60 ft., by 35 ft. high. Foundation is 15 ft. below water-level of surrounding country, and rests on three courses of 2-in. plank, spiked to sills laid in sand. No settlement has appeared.

Pumping Stations.—*Ridgewood*: Four 15,000,000-galls. pumps here, lifting total water supply 163 ft. to Ridgewood reservoir, making combined dy. cap., 60,000,000 galls. No. 1 is driven by a vertical beam-engine; No. 2 is an old pumping engine made by Beach & Woodruff, Hartford, Conn.; No. 3 is driven by a vertical beam and fly-wheel engine, made by Hubbard & Whittaker, Brooklyn. No. 4 is a Davidson pump.

Prospect: Pumping from mains to high service reservoirs. No. 1 driven by old engine, and used as reserve: No. 2, driven by a Wright engine.

Other Stations: There are 7 smaller stations, each having two pumps with dy. cap. of from 2,500,000 to 5,000,000 galls. The 8 pumps at the driven well stations are all Knowles; besides these there are 2 Davidson, and 2 Worthington pumps.

Ridgewood Reservoir.—Has cap. of 160,000,000 galls., water-surface of 25.5 acres, depth of 20 ft., is 3,400 ft. from, and 163 ft. above pump-well; is in excavation and embankment, the inner slope lined with stone wall 12 to 15 in. thick. This wall was first laid dry, but washing of the waves made breaches, and the joints were packed with cement mortar. The remedy was effective.

Mount Prospect High Service Reservoir.—Has cap. of 20,000,000 galls., area of 3.43 acres, and is about 200 ft. above tide-level.

Hempstead Storage Reservoir.—Built in '73-6. Cap., 1,000,000,000 galls.

Distribution.—*Mains*, c. i., 597 miles. *Services*, lead. *Taps*, 79,073. *Meters*, 2,021; 1,028 Crown, 560 Worthington, 418 Gem, and 15 miscellaneous. *Hydrants*, 3,702; many kinds, including Eddy, Chapman, Ludlow, Galvin. *Valves*, Eddy, Chapman, Coffin, Ludlow. *Pressure gauge*, Edson.

Consumption, 46 278,287 galls. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, about $13,100,000. Bonded debt, $11,073,500. Int., av., 5.85%. Sinking fund, $345,000. Ann. op. exp., $583,088. Ann. rev.: consumers, $1,232,397; city, none.

Management.—Chf. Engr., Robert Van Buren. Water Purveyor, Henry Hawkes. Registrar, Edw. J. O'Flynn. Pumping Engr., Edw. Fry.

NOTE:—Andrews Bros. have contract to furnish 6,000,000 galls. from a new pumping station, and other extensions are being discussed. More detailed information can be found regarding the Hempstead reservoir, over the construction of which there was much litigation, by referring to *Eng. News*, vol. V., p. 257. Other references to the same source are: on general subject of available supply, vol. VII., p. 345; general description, vol. VIII., pp. 114, and 121-2; Tests of Davidson pumping engines, vol. XII., pp. 220-2.

BUFFALO, *Erie Co.* (Pop., 155,134; est., 250,000.) At foot of lake Erie and at head of Niagara river. Has extensive manufactories and trade.

History.—Built in '52 by company, when population was abont 50,000, and purchased by city in '68. Engr., Wm. J. McAlpine, New Brighton, N. Y.

Water Supply.—Niagara river, direct pumping and pumping to reservoir. Water is drawn from the river through a tunnel 8 ft. sq., and 1,020 ft. long; the limestone rock through which it was blasted being of such a nature that it was not necessary to line it. The tunnel extends some distance under the stream and connects with an inlet of cut stone. Both of these have been enlarged in '88. Contr., Jno. Hickler.

Pumping Machinery.—Combined cap., 104,000,000 galls.; one 10,000,000 and two 15,000,000-galls. Worthington; one 15,000,000 and two 20,000,000-galls. Gaskill pumping engines.

Distribution.—*Mains*, c. i., 250 miles. *Services*, lead. *Taps*, 29,467. *Meters*, 95. *Hydrants*, Ludlow, Eddy, 2,200. *Valves*, Eddy, Ludlow.

Consumption, 38,484,936 galls. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Cost, $4,500,000. Debt, $2,778,382. Int., 3, 5 and 7%. Ann. op. exp., $127,000. Ann. rev.: consumers, $376,000; city, $100,000.

Management.—Three Commrs.: Prest., Louis P. Reichert. Sec., Jas. Ryan, and S. K. Worthington. Engr. and Supt., Louis H. Knapp.

NOTE:—A more detailed description of the tunnel and a brief account of its construction is given in Drinker's "Tunnelling," p. 862, edition of '78, or p. 956, edition of '82.

CAMBRIDGE, *Washington Co.* (Pop., 1,483; est., 1,800.) Is in townships of Cambridge, Jackson and White Creek.

History.—Built in '86 by Cambridge Water-Works Co., under 20 years franchise. Des. Engr., C. W. Knight, Rome. Const. Engr., W. C. Hawley, Cambridge. Contr., Adam Miller, Rome.

Water Supply.—Springs, direct pumping from reservoir, and pumping to reservoir. The daily flow of the springs is from 2,000,000 to 3,000,000 galls.

Reservoirs.—One, 175 ft. above and 2¾ miles from village, with cap. of 4,000,000 galls., is used only for fire protection. Another, 50 ft. below village, is a collecting reservoir, formed by earth banks, having a cap. of about 3,000,000 galls., from which the domestic supply is forced through distributing mains, the surplus going to upper reservoir, which is also fed by springs, and a stream. The 8-in. supply main from the upper reservoir is joined about ½ mile from village by the 6-in. force main from the lower reservoir; at the junction, an automatic valve, normally closed, keeps the water from flowing from the upper reservoir, until, in case of fire, the pressure from the force main is lessened and the direction of flow changed.

Pumping Machinery.—Cap., 1,000,000 galls.; made by Adam Miller & Co., Rome.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, galv. i. *Taps*, 80. *Meters*, 1. *Hydrants*, Ludlow, 35. *Valves*, Eddy.

Consumption, 40,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000. Bonded debt, $25,000. Int., 5%. Ann. op. exp., $200. Ann. rev.: consumers, withheld; city, $1,500. Hydrant rental, $40.

Management.—Prest. and Supt., Wm. McKee. Secy. and Treas., C. F. Hawley.

CAMDEN, *Oneida Co.* (Pop., 1,589; est., 2,000.) Manufactures furniture and knit goods.

History.—Built in '86 by village. Engr., E. D. Smalley, Canastota. Contrs., Sherman & McDonough, Troy.

Water Supply.—Springs and surface water, by gravity.

Reservoir.—Area, 1.64 acres.

Distribution.—*Mains*, c. i., 6.5 miles. *Services*, w. i. *Taps*, 150. *Meters* not given. *Hydrants*, Ludlow, 36. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*: Fire, 71 lbs.

Financial.—Cost, $36,000. Debt, $36,000. Int., 3¼%. Ann. op. exp., $100. Ann. rev.: consumers, $1,500; city, none.

Management.—Water Board. Secy., Fred Gamble. Treas., E. C. Mosher. Supt., S. Sherman, New Hartford.

CANAJOHARIE, *Montgomery Co.* (Pop., 2,013; est., 2,400.) On Mohawk river; incorp. a village in '29.

History.—In '52 a private company built works after plans by J. W. Perkins. Supply was from springs, by gravity for domestic use, and by pumping to reservoir for fire protection. In '84 this system was reported as having, *Mains*, c. i., 2 miles; *Services*, w. i; *Taps*, 118; *Meters*, none; *Hydrants*, 11. The works had then cost $22,000, and had a debt of $12,000 at 6%.

Report of '88 describes system of Canajoharie Water-Works Co., built in '84, which we give below.

Water Supply.—Springs in mountain, at end of 170 ft. tunnel, by gravity.

Distribution.—*Mains*, c. i., 5,000 ft, *Taps*, number not known. *Hydrants*, none.

Financial.—Cost, $22,000. Debt, $12,000. Int., 6%. Ann. op. exp., $200. Ann. rev.: $800.

Management.—Five Directors. Supt., H. G. Bragden. Report by E. C. Mosher. Both Directors.

No other data given.

CANANDAIGUA, *Ontario Co.* (Pop., 5,726; est., 7,000.) On Canandaigua lake. Settled in 1789; incorp. a village in '15.

History.—Built in '84 by private company, and controlled by Moffett, Hodgkins & Clarko, Watertown, who were the Engrs.

Water Supply.—Lake Canandaigua, pumping to tank. Water is taken from the lake 2,600 ft. from shore.

Pumping Machinery.—Worthington pump, with 14 and 20 in. cylinders and 15-in. stroke; has cap. of 1,500,000 galls., and lifts water 135 ft.

Tank.—Cap., 380,000 galls.; 40 ft. in diam. by 40 ft. high, and 135 ft. above village.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. *Taps*, 400. *Meters*, none. *Hydrants*, kind not given, 71.

Consumption, 210,000 galls. *Pressure*: Ordinary, 72 lbs. Fire, 150 lbs.

Financial.—Cost, $150,000. Debt, $125,000. Int., 6%. Ann. rev.: city, $3,550. No further financial data given.

Management.—Mgr., F. B. Merrill.

CANASTOTA, *Madison Co.* (Pop., 1,569; est., 3,000.) Manufactures glass, rakes, knives and knit goods.

History.—Built in '85 by village. Des. Engr., E. D. Smalley, Canastota. Contrs., Sherman & McDonough, Troy.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 7,000,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, c. i. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 54.

Consumption, unknown. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $70,000. Bonded debt, $70,000. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $1,500; city, none.

Management.—Supt., Decatur Gee.

CANISTEO, *Steuben Co.* (Pop., est., 3,000.) Manufacturing village.

History.—Built in '87 by Canisteo Water-Works Co. Engr., Geo. R. Harlow, Pittsburg, Pa. Contr., Jas. H. Harlow, Pittsburg, Pa.

Water Supply.—Springs, 1¾ miles from village, by gravity.

Reservoir.—Has cap. of 2,000,000 galls. and elevation of 170 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, iron, lead Pipe and specials furnished by Sayre Pipe & Foundry Co., Sayre, Pa. *Taps*, 38, more being added. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption, not yet known. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $45,000. Capital stock, $25,000. Bonded debt, $30,000. Int., 6%. For 50 hydrants $15,000 in cash was paid. Further data not known at time of report.

Management.—Prest., O. O. Laine. Secy., Geo. R. Harlow.

CATSKILL, *Greene Co.* (Pop., 4,320; est., 6,000.) On Hudson river, at mouth of Catskill creek, on hilly ground. Has manufactories.

History.—Built in '84 by village. Engr., W. S. Parker, New York. Contrs., Edw. Shanley, Catskill.

Water Supply.—Hudson river, pumping to reservoir.

Pumping Machinery.—Cap., 2,000,000 galls.; two Davidson compound condensing pumps, with steam cylinders 16 and 30-in., and water cylinders 12 in. in diam., all of 24-in. stroke.

Reservoir.—In excavation and embankment, 250 ft. above river, 154.5 by 269.5 ft. on top, 96 by 195 ft. at bottom, and 23 ft. deep. One side and part of bottom is in rock excavation.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 470. *Meters*, 4. *Hydrants*, R. D. Wood & Co.'s. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 180 lbs.

Financial.—Cost, $150,000. Bonded debt, $135,000. Int., 4%. Ann. op. exp., $3,810. Ann. rev.: consumers, $4,025.

Management.—Five Commrs. Prest., Oliver Bourke. Treas., Geo. T. Williams. Secy., Edw. Ashley. Supt., Frank P. Smith. Pumping Engr., E. A. Browere.

CHATEAUGAY, *Franklin Co.* (Pop., 680; est., 1,000.) On Chateaugay river. Has starch, butter and cheese manufactories. Settled in 1796; incorp. a village in '68.

History.—Built in '80 by Chateaugay Water-Works Co. Des. Engrs., C. E. Smith and Jno. Hughes, Chateaugay. Const. Engr., E. M. Staunton. Contrs., Goodhue & Birnie, Springfield, Mass.

Water Supply.—Spring, ½ mile from and 125 ft. above village, by gravity.

Distribution.—*Mains*, w. i. and cement, 4 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Holyoke, 15. *Valves*, Holyoke.

Consumption, 3,000 galls. *Pressure*: Ordinary, 45 to 60 lbs. Fire, do.

Financial.—Cost, $12,000. Capital stock, $10,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $800; city, $200. Hydrant rental, $13.33.

Management.—Prest., H. D. Farnsworth. Secy., Geo. G. Bently. Supt., Barney Harvey.

CHATHAM, *Columbia Co.* (Pop., 1,765; est., 3,000.) In townships of Chatham and Ghent. Manufactures straw paper.

History.—Built in '86 by Chatham Water Co. Engr., Chas. C. Hopkins, Rome. Contr., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Wm. D. Andrews & Bros. system of gang wells, pumping to reservoir.

Pumping Machinery.—Gaskill duplex pump, dy. cap., 1,000,000 galls.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 20. *Valves*, kind, do.

Consumption, 150,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 125 lbs.

Financial.—Cost, $80,000. Capital stock, $100,000. No bonded debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,500; city, $1,500.

Management.—Prest., H. W. McClellan. Treas., P. B. Blum. Secy. and Supt., Philo B. Blum, Jr.

CLINTON, *Oneida Co.* (Pop., 1,236; est., 2,000.) Has some manufactories.

History.—Built in '84 by village. Engr., F. K. Baxter, Utica. Contrs., H. J. Reed & Son, Canajoharie.

Water Supply.—Miller brook, by gravity from impounding reservoir.

Reservoir.—Formed by dam across ravine, 2½ miles from and 236 ft. above village; cap., 3,000,000 galls.

Dam.-Earth and stone, with puddle heart-wall; slopes, 2 to 1, the inner slope having a wall of field stone laid upon a foundation of boulders. Just outside the dam is a small valve-chamber, with valves for regulating the supply or emptying the reservoir. There is also a valve inside the dam, on the supply pipe; the latter has over its end a strainer attached to a telescopic arrangement of copper tubes, so that it can be raised by means of a cable, thus avoiding the necessity of a chamber.

Distribution.—*Mains*, c. i., 5 miles. *Services*, kind not given. Pipe and specials furnished by Geo. B. Hays. *Taps*, 78. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Fire, 85 to 100 lbs.

Financial.—Cost, about $36,000. Bonded debt, $35,000. Int., not given. Ann. op. exp., $1,231. Ann. rev.: consumers, $1,026. Hydrant rental, no allowance.

Management.—Five Commrs. Prest., Chas. H. Smyth. Secy., Eugene B. Woolworth. Treas., Wm. Robinson.

NOTE.—For a more detailed description, see *Eng. News*, vol. XIII., p. 135.

CLYDE, *Wayne Co.* (Pop., 2,826; est., 3,500.) In Galen township, on Clyde river Engaged in manufacturing.

History.—Work begun in fall of '88 by Clyde Water Supply Co., Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Duplex condensing, dy. cap., 1,500,000 galls.

Stand Pipe.—Cap., 200,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Hydrants*, 40.

Financial.—Capital stock, $50,000. Bonds, none issued at time of report. Hydrant rental, $40, 5 years contract.

Management.—Prest., C. R. Bassett. Secy., E. M. Bassett.

More data can be given when works are finished.

COBLESKILL, *Schoharie Co.* (Pop., 1,222; est., 1,600.)

History.—Built in '86-7 by village and operated by Cobleskill Water Co. Engr. W. N. Roberts. Contrs., Stanton & Doyle, Cohoes.

Water Supply.-Springs and surface water, by gravity from impounding reservoir.

Reservoir.—Area, 28 acres; greatest depth, 24 ft.; in addition to springs in the reservoir it receives drainage from 2,500 acres.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry and Machine Co., Phillipsburg, N J. *Taps*, 62. *Meters*, none. *Hydrants*, Mathews, 45. *Valves*, Eddy.

Consumption, not given. *Pressure*: 97 lbs., reduced to 80 lbs. by Ross Pressure. Valve, made at Troy.

Financial.—Cost, $65,000. Bonded debt, $65,000. Int., 3½ %. Ann. op. exp., $300. Ann. rev.: consumers, $1,700; city, none.

Management.—Prest. of Co., M. D. Borst. Secy., Geo. D. Harder. Supt., Jas. N. Borst.

COHOES, *Albany Co.* (Pop., 19,416; est., 21,000.) At junction of Mohawk and Hudson rivers, 3 miles from Troy and 9 miles from Albany, on ground rising from river 230 ft. Has fine water-power and extensive manufactories. Settled in 1725; incorp. a village in '48, a city in '70.

History.—Built in '48 and 57; in '48 the Cohoes Mfg. Co. laid pipes in the lower part of the village and supplied water from the upper level of their canal; in '57 these works were purchased by village for $6,000, and extensions and additions have been made since.

Water Supply.—Mohawk river, pumping to reservoirs.

Pumping Machinery.—Three 2,000,000-gall. Lang pumps, built by W. H. Lang. Goodhue & Co., Burlington, Vt., and driven by two Hercules wheels of 93 and 165 H. P.

Reservoirs.—Combined cap., 92,000,000 galls; 4,000,000, 10,000,000 and 78,000,000 galls., respectively. The last and largest reservoir was constructed in '85-6; Contrs., Houlihan & Madigan. It has an area of 14.5 acres, an elevation above business portion of 210 ft., and is in excavation and embankment. Rock and hard-pan were met on the west side and the face of the rock was plastered with cement beneath the foundation of the slope wall to prevent leakage through seams. The inner slopes were faced to the top with dry rubble stone walls, 16 in. thick, and the bottom covered with concrete. The outlet well of the reservoir is covered with a copper wire screen, made in the form of a dome, 4 ft. in diam. and 18 in. high. The elevation of the smallest reservoir is 288, and of the middle sized, 260 ft. above business part of town. The distance from the pumps to the first reservoir is about 1,500, to the second, 3,900, and to the third and largest, 6,700 ft. The force mains to the reservoirs are 10 and 16-in. pipe, part cast-iron and part cement-lined.

Distribution.—*Mains*, c. i., w. i. and cement, 25 miles. *Services*, w. i., lead, galv. i. *Taps*, 1,200. *Meters*, 56. *Hydrants*, Ludlow, 165. *Valves*, Ludlow.

Consumption, 3,000,000 galls. *Pressure*: Ordinary bs. Fire, 70 lbs.

Financial.—Cost, $266,000. Debt, $266,000. Int., 4 and 7%. Ann. op. exp., $12,000. Ann. rev.: consumers, $34,000.

Management.—Seven Commrs., including Mayor, Jno. Garside. Prest., Wm. E. Thorn. Supt., A. T. Knifer.

COLLEGE POINT, *Queens Co.* (Pop., 4,182; est., 5,000.) On Long Island, opposite and 10 miles from New York, on ground gently sloping up from the Sound. Has extensive breweries, large hard rubber, and silk, manufactories, and is place of residence for New York business men. Settled in '52; incorp. in '65.

History.—Built in '74-5 by village. Des. Engr., J. C. Rossi, with Wm. E. Worthen, New York, Consulting Engr. Const. Engr., A. D. Schlesinger. Contr. for masonry, Robt. Williams; for building, T. L. Tibbs.

Water Supply.—Springs, by direct pumping from impounding reservoir, the supply from the latter can be augmented, in case of need, by connecting with Fresh Meadow brook; the latter has a drainage area of 9½ sq. m.

Reservoir.—In excavation and embankment, walled, having an area of about 1½ acres.

Pumping Machinery.—Two Worthington pumps: one compound duplex, dy. cap., 1,500,000 galls., and one high pressure, dy. cap., 1,000,000 galls. The latter is for fire purposes.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead. *Taps*, 600. *Meters*, 100; Worthington, Gem, Crown. *Hydrants*, Mathews, 60. *Valves*, Eddy.

Consumption, 475,000 galls. *Pressure*: Ordinary, 55 to 60 lbs. Fire, 70 lbs.

Financial.—Cost, $213,000. Bonded debt, $213,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $12,000; city, none.

Management.—Water Comm.: A. D. Schlesinger and F. G. Pauly. Village Prest., Henry Kramer. Supt., Wm. Taylor.

CONEY ISLAND, *Kings Co.* See Gravesend.

History.—First supplied in '80 by works built by Benjamin F. Stephens, Flatbush. In '85 the works were sold to the Kings County Water Co., Gravesend. In '88 the Board of Health found it nesessary to erect a pumping station and lay water-pipe alongside the sewers for flushing, at an expense of $60,000. The water is taken close to a creek and is unfit for use even in the boilers at the pumping station. It is, however, offered to the people along the mains, free of charge. There is a 1,000,000-gall. Davidson pump, 6 miles of c. i. mains, furnished by R. D. Wood & Co., Philadelphia, Pa., and laid by Francis P. Gallagher, Coney Island. For flushing the sewers 240,000 galls. is pumped daily. Jno. T. McCane is Prest. of the Board of Health and T. G. Ring, Supt.

COOPERSTOWN, *Otsego Co.* (Pop., 2,199; est., 3,000.) On narrow valley at south end of Otsego lake and on Susquehanna river; bounded by abrupt hills. A trade center.

History.—Built in '35 and '79 by Cooperstown Aqueduct Association. The supply for the first works was from springs about 50 ft. above village, and was conveyed through bored wooden logs. Later, a small water-power pump, placed near lake, lifted water to a wooden tank 14 ft. in diam. by 16 ft. deep, from which it was distributed through 2 and 3-in. cast-iron pipes.

In '76 Edw. Clark built small gravity works having 150 ft. head. In '79 the company built new works. Engr., P. H. Baermaun, Troy.

Water Supply.—Otsego lake, direct pumping.

Supply Main.—Is 10-in. cast-iron, laid in Susquehanna river and into lake to a depth of 38 ft. Up to depth of 10 ft., joints were caulked with 5 wedges and the pipe laid from a float. At greater depths, a ball and socket joint was inserted at every 8 or 10 lengths, and intermediate joints caulked with lead: the pipe was then lowered from a float with a block and fall.

Pumping Machinery.—Combined dy. cap., 1,000,000 galls.; two Worthington crank pumps, driven by 50-in. Leffel turbines working under 5½ ft. head.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i., lead. *Taps*, 260. *Meters*, none. *Hydrants*, Eddy and a "mongrel pattern," 22. *Valves*, Ludlow, Eddy.

Consumption, 250,000 galls. *Pressure*: ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $42,000. Debt, $30,000. Int., 5%. Ann. op. exp., $400. Ann rev.: consumers, $4,000; city, $660. Hydrant rental, $30.

Management.—Prest., E. M. Harris. V. Prest., S. G. Browning. Secy. and Treas J. L. McNamee. Supt., Warren Lamb.

CORNELL UNIVERSITY, *Ithaca, Tompkins Co.* (Pop., not given.) On Fall creek, near south end of Cayuga lake. Opened in '68.

History.—Built in '75 by University to supply its buildings and its dwellings. Engr., Prof. E. A. Fuertes.

Water Supply.—Fall creek, pumping to distributing, from impounding reservoir. The creek has a drainage area of 30 sq. m.

Dam.—The stream is dammed directly above the "Trip Hammer Fall," by a stone masonry dam 15 ft. high, abutting on rock at each end. The wall is vertical on the lower face and battered on the upper.

Filter.—When turbid, the water is filtered through a large wooden box filled with stone-gravel and sand, which is placed in the reservoir near the gate chamber.

Pumping Machinery.—Combined dy. cap., 2,500,000 galls.; one Worthington and two Cope & Maxwell's, duplex water pressure pumps.

Reservoir.—Cap., 1,000,000 galls.; 145 ft. above University and 25 ft. above pump, with which it is connected by a 4-in. pipe; is in excavation and embankment, 100 by 144 ft. and 21 ft. deep, with inner slope covered with 2 ft. of clay puddle, on which is laid a 10-in. stone facing, grouted with Fayetteville ordinary water lime.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 150 or more. *Meters*, none. *Hydrants*, "latest Ithaca make," 11.

Consumption, 80,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 35 lbs.

Financial.—Cost, $15,000. No debt. Ann. op. exp., not given. No rev.

Management.—Supt., Prof. J. L. Norris.

CORNING, *Steuben Co.* (Pop., 4,802; est., 7,000.) On Chemung river, the ground near the river being quite level, but rising 100 ft. to the southwest. Has foundries glass factories and car manufactories.

History.—Built in '70 by town, and leased to Heermans & Lawrence for 20 years, the lessees to furnish water for fire protection, free.

Water Supply.—Monkey run creek and springs, by gravity, direct pumping, and by pumping to reservoir. The first supply was by gravity, but as it was sometimes insufficient a pump was put in and the water drawn from springs and ponds.

Reservoir.—Cap., 2,000,000 galls.; formed by dam across stream and has an elevation above river of 250 ft.

Pumping Machinery.—Martin duplex pump, dy. cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 46. *Hydrants*, Mathews, 65.

Consumption, 300,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $60,000. No debt. Ann. rev.: city, none. No further financial data given.

Management.—By lessees. Supt., H. C. Heermans.

CORTLAND, *Cortland Co.* (Pop., 4,050; est., 9,000.) On Tioughnioga river. Has various manufactories.

History.—Built in '84 by Cortland Water-Works Co., and controlled by Moffett, Hodgkins & Clarke, Watertown, who were the Contrs. Des. Engr., F. S. Pecke. Const. Engr., L. J. Richardson.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Worthington compound condensing pump of 14 and 20-in. steam, and 12-in. water cylinders, all of 15-in. stroke; dy cap., not given.

Tank.—Is 40 ft. in diam. by 40 ft. high, and is 125 ft. above and ½ miles from main street of village.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 523. *Meters*, 43. *Hydrants*, kind not given, 120.

Consumption, 400,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 150 lbs.

Financial.—Cost, $175,000. Debt, $130,000. Int., 5 %. Ann. rev.: city, $4,000. No further financial data given.

Management—Prest., B. F. Taylor. Supt., L. J. Richardson.

DANSVILLE, *Livingston Co.* (Pop., 3,625; est., 4,500.) On Mill creek, with hills on three sides. Settled in 1795; incorp. a village in '45.

History.—Fire protection system built in '74 by village. Des. Engr., D. M. Greene.

Water Supply.—Mill creek, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, wooden, 4 miles: first two miles from creek are of 10-in.

pipe, made of wooden staves, banded with iron; branches are 6 and 4 in. pipe. *Hydrants*, 54. *Pressure*: 77 lbs.

Financial.—Cost, $25,000. No debt.

Management.—Village Corporation. Treas., T. B. Grant.

DELHI, *Delaware Co.* (Pop., 1,381; est., 1,500.) On west branch of Delaware river. Incorp. a village in '21.

History.—Built in '72 by Delhi Water Co.

Water Supply.—Surface water, by gravity from impounding reservoir on brook about 5 miles long, having high hills on each side.

Reservoir.—Cap., 500,000 galls.; formed by dam 160 ft. long and 14 ft. high; is about ½ mile from and 90 ft. above village.

Filter.—Gravel, extending back through reservoir from dam, is 8 ft. wide at top, 20 at bottom, and slopes are paved with stone.

Distribution.—*Mains*, c. i., 3,5 miles. *Services*, lead. *Taps*, 190. *Meters*, none. *Hydrants*, Ayers, 33.

Consumption, not given. *Pressure*: Ordinary, 33 lbs. Fire, 33 lbs.

Financial.—Cost, $26,000. Debt, none. Ann. op. exp., $250. Ann. rev.: consumers, $1,400; city, none.

Management.—Prest., G. E. Marvin. Treas., D. T. Arbuckle. Supt., J. Middlemist.

DEPOSIT, *Broome Co.* (Pop., 1,419; est., 1,750.) Manufactures carriages, machinery, sash and blinds, and has a lumber trade.

History.—Built in '85 by Deposit Water Co., under a 10 year's franchise. Engr., Wm. B. Rider.

Water Supply.—Butler brook, by gravity.

Reservoir.—Area, ½ acre.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 75. *Meters*, none. *Hydrants*, I. S. Cassin & Co.'s, 36. *Valves*, kind, do.

Consumption, 200,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $27,000. Capital stock, $25,000. Debt, none. Ann. op. exp., $450. Ann. rev.: consumers, $780; city, $600. Hydrant rental, $20.

Management.—Prest., J. B. Perry. Secy., C. K. Brown. Supt., C. M. Putnam.

DOBBS FERRY, *Westchester Co.* (Pop., est., 2,500.) On Hudson river, 6 miles from Yonkers. Has gas burner and piano stool manufactories.

History.—Supplied in '88 by Pocantico Water-Works Co. See North Tarrytown.

DUNKIRK, *Chaalauqua Co.* (Pop., 7,248; est., 10,000.) On Lake Erie, on level ground. A commercial center. Settled in '15; incorp. a city in '80.

History.—Built in '71 by village. Contrs., Holly Manufacturing Co., Lockport.

Water Supply.—Lake Erie, by direct pumping.

Pumping Machinery.—Combined dy. cap., 4,500,000 galls.; one 2,500,000 Holly, and one 2,000,000-gall. Worthington pump.

Distribution.—*Mains*, c. i., 19½ miles. *Services*, galv. i. *Taps*, 889. *Meters*, none. *Hydrants*, Holly, 112. *Valves*, Ludlow.

Consumption, 2,400,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 105 lbs.

Financial.—Cost, $137,094. Debt, $105,000. Int., 7%. Ann. op. exp., $7,000. Ann. rev.: consumers, $8,000; city, $12,000.

Management.—Five Commrs. Prest., J. S. Biggs. Treas., W. T. Colman. Secy., Jno. Madigan. Supt., Geo. M. Abell. Pumping Engr., C. J. Carney.

ELIZABETHTOWN, *Esser Co.* (Pop., 445; est., 550.) A summer resort in Adirondack mountains, on Boquet river.

History.—Built in '83 by Elizabethtown Water Co.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, 3.5 miles. *Services*, galv. i. *Taps*, 60. *Meters*, none. *Hydrants*, Mathews, 17.

Consumption and *Pressure*, not given.

Financial.—Cost, about $18,500. Capital stock, $8,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $150. Ann. rev.: consumers, 1,000; city, none.

Management.—Prest., R. L. Hand. Secy., Treas. and Supt., R. C. Kellogg.

ELLENVILLE, *Ulster Co.* (Pop., 2,750; est., 4,000.) In valley at foot of

Shawangunk mountains. Manufactures leather, glass, veneering and pocket cutlery.

History.—Built in '71 by city. Des. Engr., Theo. Weston.

Water Supply.—Surface water, by gravity from impounding reservoir ½ mile from and 40 ft. above village.

Reservoir.—Formed by earth dam across gorge; is 50 ft. long, 20 ft. wide and 18 ft. deep.

Distribution.—*Mains*, c. i., 5.8 miles. *Services*, galv. i. *Taps*, 260. *Meters*, none. *Hydrants*, Ayers, 44. *Valves*, Kennedy.

Consumption, unknown. *Pressure*: Ordinary, 35, lbs. Fire, 130, lbs.

Financial.—Cost, $35,000. Debt, $35,000. Int., 7%. Ann. op. exp., $700. Ann. rev.: consumers, $1,600.

Management.—Prest., W. H. Deyo. Secy., B. B. Demarest. Supt., D. S Williams.

FAR ROCKAWAY, *Queens Co.* (Pop., 2,244; est., 3,000.) A summer resort on shore of Long Island.

History.—Built in '84 by private company, and extended to Rockaway Beach in '87; also supplies Averne-by-the-Sea. Const. Engr., and Contr., Robt. F. Mullins, New York. Contract for masonry and foundations sublet to David Foster, and for buildings to P. J. Powers & Son, both of Far Rockaway.

Water Supply.—About 50 gang wells, pumping to stand-pipes.

Pumping Machinery.—Combined dy. cap., 2,500,000 galls.: 1,000,000 and 1,500,000-gall. Davidson pumps. One Root sectional and one Bigelow return tubular boiler.

Stand-Pipes.—Made by Tippett & Wood, Phillipsburg, N. J.; that at Far Rockaway is 20 ft. in diam. by 100 ft. high, and the one at Rockaway Beach, 10 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., w. i., 12 miles. *Services*, galv. i. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J., Abendroth & Root, New York, and Builder's Iron Foundry, Providence, R. I. Pipe laid by T. J. Corning and Smith & Vandewater. *Hydrants*, Eddy, Chapman, Holyoke, 80. *Valves*, Eddy, Peet.

Consumption, 600,000 galls. *Pressure*: Ordinary, 43 lbs. Fire, 43 lbs., save at Rockaway Beach, 80 lbs.

Financial.—Ann. rev.: city, $4,000, half from Far Rockaway and half from Rockaway Beach. Hydrant rental, $50.

Management.—Prest., R. V. W. Du Bois, 120 Broadway, New York. Secy. and Treas., R. F. Mullins, 10 Wall St., New York. Supt., C. A. Lockwood.

FISHKILL and MATTAWEAN, *Dutchess Co.* (Pop.: Fishkill, not given: est., 682; Mattawean, est., 5,000.) Fishkill is on Fishkill creek, 5 miles from Fishkill Landing. Mattawean has water-power, used in various manufactories.

History.—Built in '86-7 by Fishkill & Mattawean Water Co. Engr., Geo. B. Inman. Contrs., Inman Bros. All of New York.

Water Supply.—Surface water, by gravity from impounding reservoir.

Reservoir.—And dam were built under separate contract by Mr. Bailey, the company's engineer.

Distribution.—Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Hydrants*, Mathews, 45. *Valves*, Ludlow.

Financial.—Hydrant rental, $50.

Management.—Prest., F. Hopkinson Smith. Secy., G. L. D'Huiller, 11 Wall St., N. Y. Supt., J. W. Phelps.

No further data given.

FLATBUSH, *Kings Co.* (Pop., 7,634; est., 10,000.) Adjoins Brooklyn, and is on irregular ground.

History.—Built in '82 by Flatbush Water-Works Co. Engr. and Contr., Benjamin F. Stephens, Flatbush.

Water Supply.—Wells, "Stephens' Patent System," pumping to stand-pipe. There are 12 wells, 8 ft. in diam. and 36 ft. deep, sunk in the saturated sand and gravel of the southern slope of Long Island.

Pumping Machinery.—Cap., 2,500,000 galls; two compound condensing duplex Worthington pumping engines.

Stand-Pipe.—Plate-iron, 20 ft. in diam. by 102 ft. high; on stone foundation, 6 ft.

above ground, which is 81 ft. above pump. The town is, on an average, 140 ft. below stand-pipe, and is between it and pumping-station.

Distribution.—*Mains*, c. i., 30 miles. *Services*, lead. *Taps*, not given. *Meters*, not given. *Hydrants*, kind not given, 142.

Consumption, 750,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Capital stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. rev.: city, $8,000. Hydrant rental, $56.34.

Management.—Prest., Secy. and Treas., not given. Supt., Jeremiah Lott.

FLUSHING, *Queens Co.* (Pop., 6,683; est., 8,000.) On Flushing bay, Long Island. Manufactures dyes, tools and has an iron foundry.

History.—Built in '74 by village.

Water Supply.—Bored wells, 17, and large pond used only for fire purposes, direct pumping.

Pumping Machinery.—Combined dy. cap., 3,000,000 galls.; one Holly and one Blake pump.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead, galv. i. *Taps*, 900. *Meters*, 140. *Hydrants*, Mathews, 113.

Consumption, 750,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Bonded debt, $198,000. Int., 5 and 7%. Ann. op. exp., $11,000. Ann. rev.: consumers, $12,600; city, $4,805. Hydrant rental, none.

Management.—Village Trustees. Supt., G. A. Roullier.

FONDA, *Montgomery Co.* (Pop., 944; est., 1,200.) On Mohawk river. Has flouring mill and carriage shop.

History.—Built in '85 by village. Engr., Samuel Moak, Amsterdam. Contr. for buildings, Jas. H. Neahr, Fonda.

Water Supply.—Springs, by gravity.

Reservoir—Cap., about 2,000,000 galls.; Contrs., Burtch & Snell, Fonda.

Distribution.—*Mains*, iron, 3½ miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and pipe laid by Miller & Knight, Saratoga. *Taps*, 78. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 31. *Valves*, kind, do.

Consumption, 100,000 galls. *Pressure*: Ordinary, 47 lbs. Fire, 47 lbs.

Financial.—Cost, $26,000. Debt, $24,000. Int., 5%. Ann. op. exp., $450. Ann. rev.: consumers, $500; city, none.

Management.—Supt., Frank H. Burtch.

FORT EDWARD, *Washington Co.* (Pop., 2,988.) On Hudson river. Has paper and other manufactories.

History.—Built for domestic supply by Geo. Taylor, (deceased,) date not given, and controlled by his widow.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, w. i. and cement. *Services*, lead.

Financial.—Cost, $10,000. No debt.

Management.—Supt., Ransom Qua. No further data can be obtained.

FORT PLAIN, *Montgomery Co.* (Pop., 2,443; est., 4,500.) In Meriden township, on Mohawk river. Manufactures axles, springs, stoves, knit and silk goods.

History.—Built in '85 by Fort Plain Water-Works Co. Engr., A. S. Betts. Contr., J. M. Low, Kingston.

Water Supply.—Springs, by gravity.

Reservoirs.—Cap., 15,000,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, Kalamein i. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 130. *Meters*, not given. *Hydrants*, Ludlow, 51.

Consumption, not given. *Pressure*: Ordinary, 79 lbs. Fire, 79 lbs.

Financial.—Cost, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,500; city, $2,040. Hydrant rental, $40.

Management.—Supt., Chas. Henneberg.

FORT HAMILTON, *Kings Co.* See Gravesend.

FREDONIA, *Chautauqua Co.* (Pop., 2,692; est., 3,500.) About three miles from Lake Erie, on undulating table land. Settled in '05; incorp. a village in '29.

History.—Built in '84 by village. Des. Engr., Emil Kuichling. Const. Engr., Geo. W. Rafter.

Water Supply.—Creek, by gravity from impounding reservoir. Creek has drainage area of 24 sq. m.

Reservoir.—Cap., 8,000,000 galls.: formed by stone dam, 120 ft. long, 25 ft. high and 17 ft. thick at base; is 3 miles from, and 240 ft. above village.

Filter.—A gate-house having 4 filtering chambers was built in dam, although it was not expected that filtering would be necessary.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i., black i. *Taps*, 340. *Meters*, 4. *Hydrants*, Mathews, 56. *Valves*, Ludlow.

Consumption, est., 50,000 galls. *Pressure*: Ordinary, 105 lbs. Fire, 105 lbs.

Financial.—Cost, $90,000. Debt, $85,000. Int., 4%. Ann. op. exp., $445. Ann. rev.: consumers, $3,600; city, none.

Management.—Commrs. Supt., E. A. Curtis.

FULTON *Oswego Co.* (Pop., 3,941: est., 4,500.) On Oswego river. Has water-power, flouring mills, paper mills, box and stove factories and knife works.

History.—Built in '85 by private company; controlled by Moffett, Hodgkins & Clarke, Watertown.

Water Supply.—Springs, pumping to tank.

Distribution—*Mains*, c. i., 4½ miles. *Services*, galv. i. *Taps*, 160. *Meters*, not given. *Hydrants*, kind not given, 32.

Consumption, 200,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 120 lbs.

Financial.—Cost, $100,090, Debt, $75,000. Int., 6 %. Ann. rev.: city, $1.280. Hydrant rental, $40, a 5 years' contract.

Management.—Treas., F. A. Emerick.

GARDEN CITY, *Queens Co.* (Pop., 574; est., 1,000.) On Hempstead plains, Long Island. Established in '74, and is maintained by estate of A. T. Stewart.

History.—Built in '76 by A. T. Stewart's estate. Engr., W. R. Hinsdale. Contr., Henry Lewis, Flushing.

Water Supply.—Well, in saturated gravel, by direct pumping. Well is 50 ft. in diam., 35 ft deep, and is lined with a brick wall extending 12 ft. above ground.

Pumping Machinery.—Four compound Holly pumps, dy. cap., 2,500,000 galls.

Distribution—*Mains*, c. i., 11 miles. *Services*, w. i. Pipe and specials furnished by Jesse W. Starr & Son, Camden, N. J. *Taps*, 100. *Meters*, none. *Hydrants*, Holly, 35. *Valves*, Holly.

Consumption, 500,000 galls. *Pressure*: Ordinary, 40 to 45 lbs. Fire 70 lbs.

Financial.—Cost, (in '82) $60,000. No debt. No further financial data given.

Management.—Supt., L. H. Cunliffe.

GENESEO, *Livingston Co.* (Pop., 1,925; est., 2,300.) On Geneseo river, on rising ground; has large machine shops.

History.—Built in '87 by village. Des. Engr., J. Nelson Tubbs, Rochester. Const Engrs., Jno. Young, Geneseo. Contrs., Coon & Mooney, Kingston, Pa.

Water Supply.—Conesus lake, pumping to reservoir. Lake is 5 miles from village, ¾ mile wide, and 9 miles long.

Pumping Machinery.—Gaskill pump, dy. cap., 600,000 galls. 40 H. P. steel tubular boiler.

Reservoir.—Is 200 ft. above main street, 150 ft. sq. and 14 ft. deep.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. Pipe and specials furnished by Sayre Pipe Foundry, Sayre, Pa. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 68. *Valves*, Rennselaer Mfg. Co.'s.

Consumption, 150,000 galls. *Pressure*: varies with elevation from 60 to 160 lbs; on main street is 85 lbs.

Financial.—Cost, $80,000. Bonded debt, $80,000. Int., 3½ %. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,000; city, none.

Management.—Commrs.: Prest., W. A. Wadsworth, J. W. Wadsworth and Theo, H. Olmstead. Secy. and Supt., Saml. H. Blythe.

GENEVA, *Ontario Co.* (Pop., 5,878: est., 7,500.) At foot of Seneca lake, in gently rolling country. Has stove and boiler works, nursery and mercantile business. Settled in 1787; incorp. a village in '06.

History.—Built in 1787 by Geneva Water-Works Co. First Engr. and Contr., W. D. Dezeng. Being extended in '87-8; Des. Engr. J. Nelson Tubbs, Rochester. Const. Engr., Geo. A. Hotchkin, Rochester. Contrs., Chambers & Casey, Rochester.

Water Supply.—Until '87, wholly from springs, by gravity from reservoirs; in that year pumping was introduced; both systems can be used jointly.

Reservoirs.—Three; area about 1 acre.

Pumping Machinery.—Worthington pump, dy. cap., 1,500,000 galls.; or 100 H. P. tubular boiler.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. Pipe and specials furnished by Jackson & Woodin M'g. Co., Berwick, Pa.; Gloucester. Iron Works, office, Philadelphia, Pa.; R. D. Wood & Co., Philadelphia, Pa., Sayre Pipe Foundry, Sayre, Pa.; Buffalo Cast-Iron Pipe Co., Buffalo. *Taps*, 300. *Meters*, 20. *Hydrants*, Mathews; contract just made for 75. *Valves*, Ludlow.

Consumption, unknown. *Pressure*, Ordinary, 20 lbs. Fire, 85 lbs.

Financial.—Cost, $126,000. Debt, $100,000. Int., 6%. Hydrant rental, old contract, $50; new contract, $45.

Management.—Prest., Stephen H. Hammond. Secy., Edw. Kingsland. Treas. Alex. L. Chew. Supt., Saml. S. Graves.

GLENS FALLS, *Warren Co.* (Pop., 4,600; est., 8,000.) On Hudson river. Manufactures lumber, lime, collars and shirts. Incorp., a village in '39.

History.—Built in '72 by village under direction of trustees. Engrs. and Contrs. American Gas and Water Pipe Co., Jersey City, N. J.

Water Supply.—Springs, by gravity from impounding and distributing reservoirs.

Reservoirs.—Impounding: cap., 75,000 galls; has area of 24 acres, depth of 14 ft., is 5 miles from and 300 ft. above village, and is formed by an earth and concrete dam. Distributing: connected with above by 5 miles of wrought iron and cement pipe; formed by dam across ravine.

Distribution.—*Mains*, w. i. and cement, 15 miles. *Services*, w. i., lead. *Taps*, 500. *Meters*, 7. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumption, 85,317 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost. $130,000. Debt, $100,000. Int., 7 %. Ann. op. exp., $700. Ann. rev.: consumers, $8,000.

Management.—Trustees. Supt., Henry E. Allen. Report made by Chas. Albo.

GLOVERSVILLE, *Fulton Co.* (Pop., 7,133; est., 10,000.) On Cayadutta creek, with high hills in vicinity. Manufactures gloves, mittens and shoe leather. Settled in '30; incorp. a village in '51.

History.—Built in '78 by village. Engr., Peter Hogan, Albany. Asst. Engr., C. W. Knight, Rome. Contrs., Flagler & Babcock, Troy.

Water Supply.—Springs, by gravity from reservoirs.

Reservoirs.—Three; combined cap., 15,000,000 galls.

Distribution.—*Mains*, c. i., 17 miles. *Services*, w. i., lead. *Taps*, 1,400. *Meters*, 22. *Hydrants*, R. D. Wood & Co.'s, 102.

Consumption, 500,000 galls. *Pressure*: Average, 80 lbs.

Financial.—Cost, $120,000. Debt, $97,500. Int., 5 and 6%. Ann. op. exp., $9,000. Ann. rev.: cousumers, $13,000; city, none.

Management.—Commrs.: Prest., F. M. Young; Secy., M. F. Button; Sup't., A. A. Hellwig.

GOSHEN, *Goshen Co.* (Pop., 2,557; est., 3,000.) In hilly, agricultural district. Settled in 1714: incorp. a village in '09 and re-incorp. in '43 and '73.

History.—Built in '71 by village. Engr., Chas. Caldwell, New York.

Water Supply.—Springs, by gravity from impounding reservoir.

Reservoir.—Cap., 46,000,000 galls.: has area of 23 acres, drainage area of 250 acres, and is 1 mile above town.

Dam.—Earth, 260 ft. long, 37 ft. high and 12 ft. wide on top.

Distribution.—*Mains*, w. i. and cement, 6 miles. *Services*, iron. *Taps*, 255. *Meters*, none. *Hydrants*, Ludlow, Chapman, 60.

Consumption, unknown, Ordinary, 56 lbs. Fire, 56 lbs.

Financial.—Cost, $75,000. Debt, $34,000. Int., 5%. Ann. op. exp., $400. Ann. rev.: consumers, $2,000; city, none.

Management.—Prest. of village, Harrison W. Mowery.

GOUVERNUER, *St. Lawrence Co.* (Pop., 2,071; est., 3,200.) On Oswegatchie river, which furnishes good water-power and is used for manufacturing purposes. Founded in '10; incorp. a village in '47. Has marble, talc, iron ore and lumber industries

History.—Built in '67 by Gouverneur Water-Works Co.

Water Supply.—Oswegatchie river, by direct pumping.

Pumping Machinery.—Dy. cap., 400,000 galls.; Green rotary pump, made by Bagley Sewal Co., Watertown, and driven by water-power.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 160. *Meters*, none. *Hydrants*, Ludlow and R. D. Wood & Co., 18. *Valves*, kind, do.

Consumption, 264,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $39,000. Capital stock, $16,000. No bonds. Debt, $4,500. Ann. op. exp., $800. Ann. rev.: consumers, $2,000; city, $700. Hydrant rental, $44.

Management.—Prest., W. Boardman. Treas., C. Anthony. Supt., C. A. Vanuzee.

GOWANDA, *Cattaraugus Co.* (Pop., 1,243; est., 2,000.) On Cattaraugus creek. Manufactures flour, plows, axes and lumber.

History.—Built in '87 by Gowanda Water-Works Co. Engrs. and Contrs., Bassett Bros., Buffalo.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 2,000,000 galls.; built by the company.

Distribution.—*Mains*, iron, 3 miles. *Services*, iron. Pipes and specials furnished by Mellert Foundry & Machine Co., Reading, Pa., and Jackson & Woodin Mfg. Co., Berwick, Pa. *Taps*, 50, but adding more. *Meters*, none. *Hydrants*, Ludlow, number not given. *Valves*, Ludlow.

Financial.—Capital stock, $20,000.

Management.—Secy., F. J. Blackman. Further data could not be given at time of report.

GRANVILLE, *Washington Co.* (Pop., 1,071; est., 2,000.) On Mettawee river. Has various manufactories. Settled about 100 years ago, but never incorp.

History.—Built in '84 by village. Engr., S. C. Randall. Work done by village.

Water Supply.—Mettowee river, pumping direct and to reservoir. A dam 20 ft. high and 200 ft. long forms a storage reservoir, and gives power for pumping.

Filter.—Sand, gravel and charcoal in wooden box 10 ft. sq. and 30 ft. long.

Pumping Machinery.—Cap., 500,000 galls.; Knowles pump with 14-in. water plunger and 16-in. stroke.

Reservoir.—On hill 50 ft. above village and 100 ft. above pump; 50 by 100 ft., by 16 ft. deep.

Distribution.—*Mains*, c. i., 4 miles. *Services*, black i. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 23.

Consumption, 2,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200; city, none.

Management.—Water Board. No Supt. Report made by J. E. Seely.

GRAVESEND, *Kings Co.* (Pop. supplied by these works varies from 10,000 to 100,000.) On southern shore of Long Island.

History.—The Kings Co. Water Supply Co. assumed the control of the Coney Island Water-Works in '85, and extended it into the township of New Utrecht, supplying in addition to Coney Island, Gravesend, Unionville, Bath Beach, Fort Hamilton, Bay Ridge and Sheepshead Bay.

The original Coney Island Works were built in '80 and consisted of two Knowles pumps, a stand-pipe, and 6 miles of mains. They were designed, constructed and owned by Benjamin F. Stephens, who was also Engr. and Contr. for the extension of the system by the new company.

Water Supply.—A series of open wells, "Stephens' Patent System," by direct pumping and pumping to stand-pipe. A new stand-pipe will soon be added.

Pumping Machinery.—Combined dy. cap., 6,000,000 galls.; two 1,000,000 gall. Knowles and two 2,000,000-gall. Worthington pumps.

Stand-Pipe.—New one will be 20 ft. in diam. and 175 ft. high.

Distribution.—*Mains*, c. i., 36 miles. *Services*, galv. i., lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 600. *Meters*, not given. *Hydrants*, Chapman, Payne, number not given. *Valves*, do.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $300,000. Bonded debt, $300,000. Int., 6%. Hydrant rental, $90. No further financial data given.

Management.—Prest., Lorrin Palmer. Treas., Wm. W. Wickes,

GREENBUSH, *Rennselaer Co.* (Pop., est., 9,000.) On Hudson river, opposite Albany. Engaged in pork-packing, milling and general manufacturing.

History.—Built in '87 by Greenbush Water-Works Co. Engr., F. S. Pecke, Watertown. Contrs., Moffett, Hodgkins & Clarke, Watertown, who control the works. Sub-Contr. for masonry and buildings, Henry Brown, Bath-on-the-Hudson. Bath-on-the-Hudson is supplied from this system.

Water Supply.—Well, 20 by 30 ft., and pipe to Hudson river, pumping to stand-pipe.

Pumping Machinery.—Two Worthington pumps, dy. cap., 4,000,000 galls.; one No. 5 condenser, and two 80 H. P., return tubular steel boilers.

Stand-Pipe.—Is 25 ft. in diam., 80 ft. high, and was made by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. Pipes and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 81. *Valves*, Ludlow.

Consumption, not yet known. *Pressure*: Ordinary, 80 to 100 lbs. Fire, 140 lbs.

Financial.—Cost, $200,000. Debt, $155,000. Int., 6%. Ann rev.: city, $3,500. No further data given.

Management.—Prest., J. F. Moffett. Secy., F. S. Fecke. Supt., Jno. Winn.

GREEN ISLAND, *Albany Co.* (Pop., 4,160; est., 5,000.) On Hudson river, opposite Troy.

History.—Being built in '88 by Green Island Water Co.; Moffett, Hodgkins & Clark have controlling interest and are doing the work.

Water Supply.—Hudson river, pumping to tank. No further data given in time for insertion here.

HASTINGS-UPON-HUDSON, *Westchester Co.* (Pop., not given.) On Hudson river, 19 miles from New York. Manufactures car wheels, asphalt brick, cigars, soap, and cuts bluestone.

History.—Supplied in '88 by Pocantico Water-Works Co.

See North Tarrytown.

HAVERSTRAW, *Rockland Co.* (Pop., 3,506; est., 6,000.) On Hudson river. Manufactures brick.

History.—Built in '86 by Haverstraw Water Co. Engr. and Cont., Jno. Lockwood, New York. Being remodeled in '88; Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Wells, direct pumping. Being changed to gravity system.

Reservoir.—Cap., 100,000 galls.

Pumping Machinery.—Holly pump, dy. cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 140. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $100,000. Capital stock, $60,000. Bonded debt, $40,000. Int., 6%. Ann. rev.: city, $1,400. Hydrant rental, $40. No further financial data given.

Management.—Prest., Jno. Lockwood, 52 Broadway, New York. Supt., D. D. Williams.

HERKIMER, *Herkimer Co.* (Pop., 2,359; est., 4,000.) On Mohawk river, in dairying district. Manufactures air-guns, knit goods and paper.

History.—Built in '88 by village. Engrs., J. R. & F. K. Baxter, Utica. Contrs., Beckwith & Quackenbush, Herkimer.

Water Supply.—Driven wells, pumping to stand-pipe.

Pumping Machinery.—Knowles pump, dy. cap., 500,000 galls.

Stand Pipe.—Is 25 ft. in diam. by 60 ft. high.

Distribution.—*Mains*, c. i., 7 miles. *Hydrants*, 51. *Pressure*: Ordinary, 80 lbs.

Financial.—Cost, $50,000.

Management.—Water Board. Prest., W. B. Howell. Secy., Chas. C. Spinner.

Report made before works were finished, hence incomplete.

HILLBURN, *Rockland Co.* (Pop., 350; est., 450.) On Ramapo river, in hilly country. Founded in '72 by Ramapo Wheel & Foundry Co.

History.—Built for domestic supply in '73 by above company, after plans by W. W. Snow, their Supt.

Water Supply.—Small stream, by gravity from small reservoir about 60 ft. above village.

Distribution.—*Mains*, Wyckoff wood, 0.9 miles. *Services*, galv. i. *Taps*, 80.

Consumption, unknown. *Pressure*: 45 hydrants.

Financial.—Cost, $4,000. No debt. Ann. op. exp., none. Ann. rev.: consumers, $960.

Management.—Supt., W. W. Snow.

HOBART, *Delaware Co.* (Pop., est., 1,000.) On branch of Delaware river. Manufactures farming implements and butter firkins.

History.—Built in '87 by Hobart Water Co., under 99 years' franchise. Engr., Geo. N. Cowan, Stamford. Contr., Francis Leonard, Norwalk, Conn.

Water Supply.—Spring brook, by gravity.

Reservoir.—Cap., 380,000 galls.

Distribution.—*Mains*, cement, 2 miles; made by Norwalk (Conn.) Water Pipe & Construction Co. *Services*, lead. *Taps*, 16. *Meters*, none. *Hydrants*, Holyoke, 10. *Valves*, Ludlow.

Consumption, 1,000 galls. *Pressure*: Fire, 60 lbs.

Financial.—Cost, $10,225. Debt, $2,000. Int., 6%. Ann. rev.: consumers, $300. Further data not determined at time of report.

Management.—Prest., Jas. Cowan. Secy., Jas. R. Scott.

HOMER, *Cortland Co.* (Pop., 2,331; est., 3,500.) Manufacturing village in agricultural and dairy country.

History.—Built in '86 by private company; controlled by Moffett, Hodgkins & Clarke, Watertown N. Y.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—No data given.

Tank.—No data given.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 72. *Meters*, 6. *Hydrants*, kind not given, 33.

Consumption, 70,000 galls. *Pressure*: Ordinary, 120 lbs.

Financial.—Cost, $50,000. Debt, $45,000. Int., 6 %. Ann. rev.: city, $1,650. No further data given.

Management.—Supt. L. J. Richardson.

HONEOYE FALLS, *Monroe Co.* (Pop., 1,098; est., 1,800.) On Honeoye creek, 14 miles South of Rochester. Has several manufactories.

History.—Built for domestic supply in '88 by Honeoye Falls Water-Works and Improvement Co. Contr. for buildings, G. S. Williamson, Honeoye Falls Company laid its own pipe.

Water Supply.—Wells, pumping to tank.

Pumping Machinery.—Cap., 48,000 galls.: made by Barr & Creelman, Rochester.

Tank.—Cap., 1 000 galls.

Distribution.—*Mains*, c. i., 2 500 ft. *Services*, w. i. Pipe and specials furnished by Barr & Creelman, Rochester. *Taps*, 20. *Meters*, not given.

Financial.—Cost, $2.600. Capital stock, $2,500. Debt, $150.

Management.—Prest., W. G. Starr. Secy. and Treas., A. R. Holden.

HOOSICK FALLS, *Rennselaer Co.* (Pop., 4,530; est., 7,000.) On Hoosick river. Manufactures shirts, malleable iron and agricultural implements.

History.—Built in '86-7 by Hoosick Falls Water Supply Co. Des. Engr., G. Norman Weaver, Newport, R. I. Contr., Geo. H. Norman, Newport, R. I.

Water Supply.—Wells, pumping to tank.

Pumping Machinery.—Cap., not given; Knowles and Russell pumps, and Cunningham boiler.

Tank.—Made by Cunningham Iron Works, Boston, Mass.; 40 ft. in diam. and 35 ft. high.

Distribution.—*Mains*, w. i. and cement, 8¼ miles. *Services*, iron. *Taps*, 250. *Meters*, 2. *Hydrants*, Chapman, Eddy, Holyoke, 84. *Valves*, kind, do.

Consumption, not given. *Pressure*: Ordinary, 80 to 120 lbs. Fire, do.

Financial.—Capital stock, $100,000. Bonds, $100,000. Ann. rev.: consumers, $2500; city, 3,000. Hydrant rental, $40. No further financial data given.

Management.—Prest., John Lockwood. Treas., G. Norman Weaver. Secy. and Supt., E. R. Eastabrook.

HORNELLSVILLE, *Steuben Co.* (Pop., 8,195; est., 13,000.) On Canisteo river: manufacturing town and center of trade. Settled in '20; incorp. a village in '52.

History.—Built in '81 by Hornellsville Water Co. Des. Engr., W. B. Rider, South Norwalk, Conn. Const. Engr. Arthur L. Betts.

Water Supply.—Mountain streams, by gravity from impounding reservoirs.

Reservoir.—Cap., 50,000,000 galls.; formed by dam 450 ft. long, and 23 ft. high: has area of 15 acres, is 5 miles from and 220 ft. above village. Supply main is of 16-in. cast-iron.

Filter.—In outlet chamber of dam, consisting of gravel and charcoal between wire screens.

Distribution.—*Mains*, c. i., 19 miles. *Services*, galv. i., lead. *Taps*, 800. *Meters*, 1. *Hydrants*, kind not given, 130. *Pressure gauge*, Edson.

Consumption, unknown. *Pressure*: Ordinary, 95 lbs. Fire, 86 lbs.

Financial.—Cost, $200,000. Capital stock, $125,000. Bonded debt, $150,000. Int., 6 %. Ann. rev.: city, for hydrants, $3,900. Hydrant rental, $30.

Management.—Pres., N. M. Crane. Secy., S. H. Crane. Supt., Geo. L. Tubbs.

HUDSON, *Columbia Co.* (Pop., 8,670; est., 10,000.) On Hudson river. A slate bluff rises abruptly 60 ft. from river, and from this the ground rises gradually for 1½ miles to Prospect hill, 500 ft. above river. Engaged in manufacturing and trade. Settled in 1783; incorp. a city in 1785.

History.—Early in this century a supply of drinking water was introduced through an iron pipe from a spring 2 miles distant.

In '74-5 the population being about 8,000, works were built by city. Engrs., J. B. G. Rand and J. H. Emigh.

Water Supply.—Hudson river, pumping to filters, the filtered water passing to a storage and distributing reservoir.

Pumping Machinery.—Cap., 1,500,000 galls. *in* 10 *hours*; made by Clapp & Jones Mfg. Co., Hudson.

Filters.—Two, adjoining reservoir on Prospect hill, with a crest area of 9,081 and 15,081 sq. ft., respectively, and a depth of 13½ ft. Water is admitted to the smaller basin through a masonry well, the wall of which is even with the top of the filtering material, over which the water flows. The filtering material is in layers:—6 in. fine, white sand; 18 in. coarse, dark sand; 6 in. ¼-in. gravel; 6 in. ½-in. gravel; 6 in. 1-in. broken stone; 6 in. 2-in. broken stone; 24 in. 4 to 8-in. broken stone. Total, 72 in. The bottom of the basin is a 6-in. layer of concrete, sloping slightly towards center and outlet. A dry masonry stone culvert leads along bottom of basin to an effluent chamber, from which water passes to storage reservoir, or can be drawn directly to city. When dirty the top layer of fine sand is removed with flat shovels to a depth of 1 in., washed and replaced. A new filter is being built in '88.

Reservoir.—Has cap. of 3,200,000 galls., area of 32,696 sq. ft. and depth of 20 ft.; inner slopes are 1½ to 1, faced with dry rubble masonry, 12 in. thick at crest and 18 at bottom, laid on 9 in. of 2 in. broken stone. The filter works so satisfactoryly that the turbid river water becomes clear to a depth of 15 ft. in the clear water or storage reservoir. From a gate-house near inlet an 18-in. pipe leaves the reservoir and branches into two 12-in. supply mains.

Distribution.—*Mains*, c. i., 14.3 miles. *Services*, lead, galv. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. and Florence Iron Works. *Taps*, 1,251. *Meters*, none *Hydrants*, Ludlow, Mathews, 185. *Gates*, kind, do. 110.

Consumption, 1,267,825 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Cost, $300,000. Debt, 200,000. Int., 3½ and 7 %. Ann. op. exp., $11,532. Ann. rev.: consumers, $2,000; city, none.

Management.—Six Commrs. Prest., Wm. H. Traver. Secy., P. Miller.

IRVINGTON, *Westchester Co.* (Pop., 1,904; est., 2,500.) On Hudson river, on hilly ground. Summer resort, and engaged in horticulture.

History.—Built in '84 by village. Engr., H. C. Pearson. Contrs., R. D. Wood & Co., Philadelphia, Pa., and Inman Bros., New York.

Water Supply.—Stream and artesian well, pumping to reservoir.

Reservoir.—Cap., 9,000,000 galls.; is 1½ miles from and 412 ft. above village, formed by enlarging, puddling and paving an old pond; 150 by 300 ft., by 20 ft. The reservoir was first filled from the stream, but as this could be depended upon only 6 months in the year an artesian well, 8 in. in diam. and 605 ft. deep, and yielding 26,000 galls. daily, was sunk, and water pumped from it to reservoir.

Pumping Machinery.—Worthington duplex pump, dy. cap., 250,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 100. *Meters*, 100. *Hydrants*, Mathews, 25.

Consumption, 15,000 galls. *Pressure*: Ordinary, 170 lbs. Fire, 175.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 4%. Ann. op. exp., $2,500. Ann. rev.; consumers, $5,000; city, $1,000.

Management.—Supt., W. H. Winne.

ITHACA, *Tompkins Co.* (Pop., 9,105; est.,12,000.) At head of Cayuga lake, surrounded on three sides by, and partly upon, hills; the remainder of the village is on level land. Engaged in manufacturing. Settled in 1789: incorp. a village in '21.

History.—Built in '72 by Ithaca Water-Works Co. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Buttermilk Falls creek, by gravity from impounding and distributing reservoirs. Creek has drainage area of 10 sq. m.

Dams.—Impounding reservoirs formed by dams of cribs of white pine timber, filled with small stone grouted with cement.

Reservoirs.—Two impounding: first is 3 miles from and 500 ft. above village, and has cap. of 10,000,000 galls; second is down stream, 1 mile from and 212 ft. above village, cap., 1,500,000 galls. Higher parts of village are supplied directly from second reservoir. Distributing reservoir: at and 146 ft. above village, holding 1,350,000 galls., and connected with lower impounding reservoir with 2 miles of 8-in. cast-iron pipe; is on side hill, with rock foundation; built of cement laid stone masonry, lined with brick and backed on outside with earth, which is supported by a stone retaining wall. The bottom is covered with from 18 to 24 in. of concrete.

Distribution.—*Mains*, c. i., 16 miles. *Services*, w. i., galv. i. *Taps*, 475. *Meters*, 8. *Hydrants*, 70: made by Freeman, Waterman & Co., Ithica. *Valves*, kind, do.

Consumption, 160,000. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $204,000. Capital stock, $100,000. Bonded debt, $75,000. Int., 6%. Hydrant rental, $60. No further financial data given.

Management.—Prest., Leonard Treman. Treas., L. L. Treman. Secy. and Supt., E. M. Treman.

JAMAICA, *Queens Co.* (Pop., 3,922; est., 5,500.) On Long Island, 10 miles from Brooklyn; engaged largely in market gardening.

History.—Built in '87 by Jamaica Water Supply Co. Engr., Jno. Lockwood, New York.

Water Supply.—Six 6-in. pipe wells, 40 ft. deep, by pumping to tank.

Pumping Machinery.—Holly pump and boilers, dy. cap., 2,000,000 galls.

Tank.—On elevation of 130 ft., and is 50 ft. in diam. by 40 ft. high. Contr., Christopher Cunningham, Greenpoint.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and specials by Builder's Iron Foundry, Providence, R. I. *Taps* and *Meters*, not given. *Hydrants*, Holly, 60. *Valves*, Holly.

Consumption, not given. *Pressure*: Ordinary, 56 lbs. Fire, 56 lbs.

Financial.—Cost, $150,000. Capital stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. rev., $2,220; village pays $370 a mile for 6 miles of pipe. Other data could not be given at time of report.

Management.—Prest., Jno. Lockwood, New York. Secy., A. K. Gregory. Engr.-in-Charge, Jno. Bush.

JAMESTOWN, *Chautauqua Co.* (Pop., 9,357; est., 16,000.) At outlet of Chautauqua lake, on hills rising from stream about 200 ft. Engaged in manufacturing. Settled in '10: incorp. a village in '27.

History.—Built in '82 by Jamestown Water Supply Co. Engrs. and Contrs., Holly Manufacturing Co., Lockport.

Water Supply.—Artesian wells, by direct pumping. Four new wells, 8-in. in diam. and yielding 2,000,000 galls., daily, have recently been driven, and a new pumping station built, 4 miles from the first station.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly quadruplex pump. Kind and dy. cap. of new pump not given.

Distribution.—*Mains*, c. i., 17 miles. *Services*, w. i. *Taps*, 900. *Meters*, 10. *Hydrants*, Holly, 106.

Consumption, 750,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $200,000. Bonded debt, $100,000. Int., 6%. These figures do not include the cost of current extensions. $100.000. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,000; city, $6,300. Hydrant rental, $60 for first 100, $50 for additional.

Management.—Prest., S. B. Broadhead. Treas., W. A. Kent. Secy., E. Morgan. Supt., A. F. Kent.

JOHNSTOWN, *Fulton Co.* (Pop., 5.013; est., 8,000.) On Cayadutta creek. Manufactures gloves, mittens and shoe leather.

History.—Built in '78 by village. Engr., P. H. Baermann, Troy.

Water Supply.—Springs and streams, by gravity from impounding and distributing reservoirs.

Reservoirs.—The storage reservoir is formed by a timber dam across Cold brook, has an area of ½ acre and a depth of 12 ft. From this, 2.700 ft. of 8-in. pipe, with a fall of 33 ft. and 700 ft. of 6-in. pipe, with a fall of 130 ft., leads to distributing reservoir, formed by an earth dam, across ravine, 250 ft. long and 25 ft. high, with a puddle wall in center. This reservoir has a cap. of 10,000,000 galls., a water area of 2½ acres, is from 186 to 282 ft. above town, and is connected with the distribution system by 19,377 ft. of 10-in. cast-iron pipe. A dam 5 ft. high across Warren brook forms a second storage reservoir, connected with the distributing reservoir by 515 ft. of 12-in. cast-iron pipe.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. *Taps*, 852. *Meters*, 20. *Hydrants*, Mathews, 70. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*, Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $121,500. Bonded debt, $60.500. Int., 6%. Ann. op. exp., $1,728. Ann. rev.: consumers, $8.565.

Management.—Four Commrs. Supt., J. J. Buchanan.

JORDAN, *Onondaga Co.* (Pop., 1,344; est., 2,000.) Engaged in manufacturing.

History.—Built and owned by individual, date built and name of owner not given.

Water Supply.—Outlet of Skaneateles lake, pumping to reservoir.

Pumping Machinery.—Dy. cap., 400,000 galls.; driven by water-power, kind not given.

Reservoir.—Cap., 30,000 galls.

Distribution.—*Mains*, w. i., 0.5 miles. *Services*, w. i. *Taps*, 20. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—No debt. No further data given.

Management.—Not given. Report made by S. Rockwell.

KEESEVILLE, *Essex Co.* (Pop., 2,181; est., 2,500.) On both sides Ausable river. Has some manufactories. Settled in 1794; incorp. a village in '78.

History.—Built in '83 by village. Engr., W. H. Lang, Burlington, Vt.

Water Supply.—Ausable river, by direct pumping.

Pumping Machinery.—Combined dy. cap., 2,000,000 galls.; one Flanders and one Lang pump, the latter made by B. S. Nichols & Co., now W. H. Lang, Goodhue & Co., Burlington, Vt.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i. *Taps*, 185. *Meters*, none. *Hydrants*, Ludlow, 49. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 68 lbs. Fire, 150 lbs.

Financial.—Cost, $38,000. Debt, $27,000. Int., 5%. Ann. op. exp., $500. Ann. rev.: consumers, $1,600; city, $2,350.

Management.—Commrs. Prest., W. Harper. Secy. and Treas., H. M. Mould. No Supt.

KINGSTON, *Ulster Co.* (Pop., 18,344; est., 23.000.) On Hudson river, at mouth of Roundout creek, and comprises the post-offices of Kingston, Roundout and Wilbur. Engaged in manufatcuring, and has large river trade. Settled in 1666; incorp. a city in '72.

History.—Built in '83 by Kingston Water Co. Engr., Arthur L. Betts. Contr., Jos. M. Low, Kingston.

Water Supply.—Sawkill creek, by gravity from impounding reservoir. Creek has drainage area of 25 sq. m. above reservoir.

Reservoir.—Cap., 60,000,000 galls.; has area of 19¾ acres, is 7 miles from city, 350 ft. above mean tide water, giving a head of 170 ft. at Kingston and 340 ft. on the strand at Roundout.

Dam.—Reservoir formed by earth dam 195 ft. long, 35 ft. high, with heart-wall of masonry, founded on solid rock.

Filter.—Water is taken from near surface of reservoir, and passing through charcoal and gravel filter is conveyed to city through 37,500 ft. of 18-in. pipe.

Distribution.—*Mains*, c. i., 33.5 miles. *Services*, w. i., lead. Families supplied, 1,760. *Meters*, 35. *Hydrants*, Coffin, 255. *Valves*, Coffin.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 103 lbs. Fire, 103 lbs.

Financial.—Cost, $600,000. Capital stock, $300,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., $4,580. Ann. rev.: consumers, $17,600; city, $10,000. Hydrant rental, $40.

Management.—Prest., Jas. L. Lindsley. Secy. and Treas., C. D. Bruyn, Supt., Alfred Hudler.

LANSINGBURGH, *Rennselaer Co.*, (Pop., 7,432; est., 9,000.) A suburb and branch post-office of, and 1 mile from, Troy. Manufactures collars, cuffs, shirts, brushes, oilcloth and carriages. Settled in 1771; incorp. a village in 1790.

History.—Built in '84 by village. Des. Engr., P. H. Baermann, Troy. Const. Engr., W. M. S. Franklyn. Contrs., Sherman & McDonough, Troy.

Water Supply.—Oil Mill creek, by gravity from impounding and distributing reservoir. Creek has drainage area of 3 sq. m.

Rerervoirs.—Impounding: cap., 80,000,000 galls.; area, about 33 acres; formed by earth dam; about 265 ft. above village. Distributing: Cap., 15,000,000 galls.; 194 ft. above village.

Distribution.—*Mains*, c. i., 14 miles, furnished by Gloucester Iron Works, office, Philadelphia, Pa. *Services*, lead. *Taps*, 627. *Meters*, 2. *Hydrants*, Ludlow, 129. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 71 lbs. Fire, 71 lbs.

Financial.—Cost, $160,000. Debt, $160,000. Int., 4%. Ann. op. exp., $8,000, Ann. rev.: consumers, $7,112; other sources, $30,262.

Management.—Five Commrs. Prest., E. Tracy. Secy., H. S. Holmes. C. H Dauchey. Supt., J. Brooks.

LE ROY, *Genesee Co.* (Pop., est., 2,800.) On Oatka creek, which furnishes. good water power. Manufactures salt, malt, paper, patent medicines and carriages.

History—Built for fire protection in '75 by village. Engrs., La France Steam Fire Engine Co., Elmira. Contrs., Wm. Sherman and Drulard & Hayes.

Water Supply.—Oatka creek, by direct pumping.

Pumping Machinery.—La France pumps, cap., not given, driven by power from Prentice's Flouring Mill.

Distribution.—*Mains*, c. i., 2 miles. *Hydrants*, 18. *Pressure*, 110 to 140 lbs.

Financial.—Cost, $8,000. Ann. op. exp., $600. No further data given.

Management.—By village. Reports made by F. H. Morgan and S. D. Gilbert.

LITTLE FALLS, *Herkimer Co.* (Pop., 6,910; est., 10,000. On Mohawk river, which furnishes good water-power used for manufacturing purposes.

History.—Begun in '85, and finished in '88, by village. Engr., Stephen E. Babcock, Little Falls.

Water Supply.—Beaver creek, by gravity from impounding and distributing reservoirs.

Reservoirs.—Impounding: cap., 1,000,000 galls.; formed by masonry dam, 6 ft. high, having a 50-ft. spill-way, and flooding ¾ acres. Distributing: cap., 25,000,000 galls. Contrs., Hallivan Bros.

Conduit.—Connecting the reservoirs; of salt-glazed vitrified stone-ware pipe, with cast-iron pipe substituted at the crossing of two valleys. From the impounding reservoir water is taken from a chamber for the first 50 ft. through a 20-in cast-iron pipe, then for 10,000 feet through 20-in. stone-ware pipe, with a grade of 8 ft. to the mile; from here the size and material of the pipe changes, in accordance with the grade, until a total length of 8.72 miles is attained and the distributing reservoir reached. Contrs., Sherman & McDonough, Troy.

Distribution.—*Mains*, c. i., 17 miles. *Services*, lead. Pipes and specials furnished by Warren Foundry & Machine Co., Philipsburg, N. J., and pipe laid by T. Sullivan & Co. *Taps*, 400. *Meters*, Crown and Worthington, 10. *Hydrants*, Ludlow, 130. *Pressure gauge*, Edson. *Pressure valves*, Ross.

Consumption.—4,000,000 galls. *Pressure*: Ordinary, 140 lbs. Fire, 140 lbs.

Financial.—Cost, $300,000. Debt, $300,000. Int., 3½ %. Further financial data not given, as works were not completed at time of report.

Management.—Commrs. Prest., Wm. J. Skinner. Secy., C. J. Palmer. Engr., in-charge, Stephen E. Babcock.

LOCKPORT, *Niagara Co.* (Pop., 13,522; est., 18,000.) On Erie canal, which descends 60 ft. here, furnishing water-power used for manufacturing. City is on two plains, the lower is nearly level, the upper is 60 ft. above it, slightly back from bluff. Incorp. a city in '65.

History.—Built in '58 by the Holly Manufacturing Co. Des. Engr., Julius Froshee. Const. Engr., Harvey Gaskill. New works have been finished in '88, by the Holly Manufacturing Co., to be owned by city. Stainthorpe & Houston have contract for masonry and foundations.

Water Supply.—Erie canal, by direct pumping, water being drawn from canal through a tunnel.

Pumping Machinery.—Dy. cap., 4,500,000 galls.: Gaskill pump and Holly boiler.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. *Taps*, 1,000, *Meters*, 10, *Hydrants*, Holly, 186. *Valves*, Holly.

Consumption, 150,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 3½ %. Ann., op. exp., $8,000. Ann. rev.: consumers, $7,000; city, $5,000.

Management.—For new, works not given.

LONG ISLAND CITY, *Queens Co.* (Pop., 17,129; est., 30,000.) On Long Island and East River, opposite center of New York City, and adjoining Brooklyn. Has level surface. Engaged in manufacturing. Incorp. under its present name in '70.

History.—Built in '74 by city. Engr. Wm. E. Worthen, New York.

Water Supply.—Dug and driven wells, by direct pumping. The first well was 50 ft. in diam., sunk 30 ft. in saturated sand. The well has a 16 in. brick wall, resting on an iron shoe, and was sunk by excavating inside and letting the wall settle. In the bottom of the well three 4-in. pipes were driven down 20 ft. In '82 six 6 in. wells were driven 75 to 90 ft. deep, near by, and connected with the suction pipe of the pumps; these are used when necessary.

In '79 a second large well 15 ft. in diam. and 20 ft. deep, was sunk, 3 miles from the first. Contr. for wells, Jno, Woodruff.

Pumping Machinery.—Worthington at first, and Garrison at second, well; dy. cap., not given.

Distribution.—(In '82.) *Mains*, c. i., 16 miles. *Services*, galv. i. *Taps*, 1,050. *Meters*, 27. *Hydrants*, 250.

Consumption, 1,500,000. *Pressure*; Ordinary, 45 lbs. Fire, 70 lbs.

Financial.—(In '82.) Ann. op. exp., 12,000. Ann. rev.: consumers, $37,000.

Management.—Water Commrs. In charge of P. J. Harrigan.

NOTE:—No later date regarding distribution or finances can be obtained, although personally solicited. The other data is correct to date.

LYONS, *Wayne Co.* (Pop., 3,820; est., 6,000.) On Clyde river. Has pottery and machine shops, peppermint oil distilleries, and manufactories of barrels and farm implements. Settled early in this century.

History.—General supply introduced in '87 by Lyons Water-Works Co. Des. Engr., W. S. Parker. Const. Engr., Geo. Brandon. Contrs., Ryan & McDonald, Waterloo.

In '77 a small system for domestic supply was built by a private company, water being taken from springs and lifted to reservoir by pump driven by windmill. There was 1.5 miles of pipe, and 100 taps.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Davidson pump, dy. cap., not given.

Stand Pipe.—Is 20 ft. in diam. and 50 ft. high.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i. *Taps*, not given. *Meters*, 4. *Hydrants*, Ludlow, 40.

Consumption, not known. *Pressure*: Ordinary, 84 lbs. Fire, 88 to 90 lbs.

Financial.—Cost, $100,000, No debt. Ann. rev.: consumers, $1,500; city, $1,600 Hydrant rental, $40, 5 years' contract.

Management.—Prest., C. J. Ryan. V. Prest., I. H. Camp. Secy. and Treas., D. P. Foster. Supt., Melvin H. Brandon.

MALONE, *Franklin Co.* (Pop., 4,193; est., 5,000.) On Salmon river, in undulating country. Has some manufactories. Settled in '05; incorp. a village in '53.

History.—Built in '57 by Malone Water-Works Co., and being extended in '88. Engr. for extensions, D. M. Greene, Troy. Contr., Edgarton Bynner, New York.

Water Supply.—Springs, by gravity to and from reservoir. The new supply will be from 3 additional springs, 8 miles from village.

Reservoir.—Old; 60 by 30 ft., by 8 ft. deep; in earthwork, 75 ft. above village. New; Collecting, 20 by 30 ft.; and distributing, 200 ft. sq.

Distribution.—*Mains*, 14 miles; old, w. i. and cement; new, c. i. *Services*, not given. *Taps*, 250. *Meters*, none. *Hydrants*, 55.

Consumption and *Pressure*, not given.

Financial.—Cost, $45,000. No debt. New work est. to cost, $90,000. Ann. rev.: consumers, $7,000; city, $170.

Management.—Seven Commrs. Prest., C. L. Hubbard. Supt., Geo. Sabin.

MAMARONECK, *Westchester Co.* (Pop., 1,863; est., 2,000.) On Long Island Sound; residence of New York business men.

History.—Built in '85 by Mamaroneck Water Co. Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Mamaroneck river, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., 50,000 galls.

Reservoir.—Cap., 1,000,000 galls.; about 80 ft. above tide-water.

Distribution.—*Mains*, w. i., 6 miles. *Services*, c. i. *Taps*, 36. *Meters*, 10. *Hydrants*, kind not given, 10.

Consumption, 10,000 galls. *Pressure*; unknown.

Financial.—Cost, $65,000. Capital stock, $25,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $1,600. Ann. rev.: consumers, $1,600; city, none.

Management.—Prest., Jas. M. Constable. Secy. and Treas., W. T. Cornell Supt. and Engr., Louis Ottman.

MANLIUS, *Onondaga Co.* (Pop., 834; est., 1,000.)

History.—A small system, date built not given, owned and kept in repair by parties along the main.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, iron, ¼ mile. *Services*, iron. *Taps*, 18. *Meters*, none. Three cisterns for fire protection.

Financial.—Cost, $500 for pipe and pipe laying.

Management.—Prest., Chas. Hart. Secy., F. H. Dewy. Treas., Henry Whiting.

MATTAWEAN, *Dutchess Co.* See Fishkill & Mattawean.

MEDINA, *Orleans Co.* (Pop., 3,632; est., 5,000.) On Oak Orchard creek, which furnishes water-power used in various manufactories.

History.—A fire protection system, built in '60 by village.

Water Supply.—Oak Orchard creek, by direct pumping.

Pumping Machinery.—Hawley pump, dy. cap., not given.

Distribution.—*Mains*, iron, 2 miles. *Hydrants*, kind not given, 20. *Pressure*: 125 lbs.

Financial.—Cost, not given. No debt. Ann. op. exp., $500.

Management.—Supt., G. E. Allen.

MIDDLETOWN, *Orange Co.* (Pop., 8,494; est., 9,000.) On Mohegan creek, in a hilly region. Trade and manufacturing center. Settled in 1755; incorp. a village in '48.

History.—Built in '67 by village.

Water Supply.—Springs and surface water by gravity and by pumping to reservoir.

Reservoir.—The first supply was from an impounding reservoir receiving the drainage from 8 sq. m., and was formed by an earth dam 25 ft. high across a narrow valley, which flooded 60 acres, and gave a cap. of 300,000,000 galls., 150 ft. above town. This supply was insufficient and in '75 was supplemented by pumping from Shawangunk Kill through a conduit.

Pumping Machinery.—Holly pump, with 20-in. bore and 12-in. stroke.

Conduit.—Wooden, 12-in. in diam. and 3½ miles long; made of 2¾-in. pine staves, banded with strap-iron, and coated on the outside with tar. The pipe follows the surface, descending 75 ft. below, and rising 25 ft. above, the reservoir, yet though, owing to litigation, it was unused for 6 years, at the end of the period only three breaks occurred.

Distribution.—*Mains*, wood, c. i. and cement, 16¼ miles. *Services*, galv. i. *Taps*, about 550. *Meters*, 14. *Hydrants*, kind not given, 115.

Consumption, not given. *Pressure*: 55 to 85 lbs.

Financial.—Cost, $180,721. Bonded debt, $154,000. Int., 4, 5 and 6%. Ann. op. exp., $15,104. Ann. rev.: $16,479.

Management.—Water Commrs. Prest., H. R. Wilcox. Clerk. D. F. Seward. Supt., not given.

MORAVIA, *Cayuga Co.* (Pop., 1,540; est., 2,000.) Has some manufacturing.

History.—Built in '84 by Moravia Water-Works Co. Des. Engr., S. H. Morgan. It is reported that the works are being extended in '88 to supply Groton, with Chas. Millar & Sons, Utica, Contrs. for material.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 150,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i., black i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and Geo. B. Hayes. *Taps*, 100. *Meters*, none. *Hydrants*, Bailey, 30.

Consumption, not given. *Pressure*: Ordinary, 86 lbs. Fire, 86 lbs.

Financial.—Cost, $40,000. Capital stock, $30,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $400. Ann. rev.: consumers, $1,000; city, $900. Hydrant rental, $30.

Management.—Prest., S. H. Morgan. Secy., A. A. Morgan. Treas. and Supt., Fred C. Reynolds.

MOUNT MORRIS, *Livingston Co.* (Pop., 1,899; est., 2,500. Engaged in manufacturing and agriculture. Settled in 1794; incorp. a village in '30.

History.—Built by Mills Water-Works Co., under 30 years' franchise. Des. Engrs., J. Nelson Tubbs and Byron Holly, Rochester. Const. Engr., Byron Holly.

Water Supply.—Springs, by gravity to and from reservoir. The springs crop out in an area of 30 acres of fine sand, at the base of hills of sandy loam, 1 mile west of village. Around, and 10 ft. from each spring 5-in. horse-shoe tile is laid 3 ft. below the surface, conducting the water to masonry and cement wells, 3 ft. sq. and 6 ft. deep. Owing to quicksand in the water these wells are cleaned out once in months. From the settling wells 2-in. wrought-iron pipes carry the water to a larger well, and from here ¾ miles of 4-in. pipe leads to a reservoir.

Reservoir.—In excavation and embankment, 125 ft. sq. by 13 ft. deep; the bottom and inner slopes are paved with stone, grouted and plastered with cement. There is a masonry waste and supply chamber, and the flow line is 100 ft. above village.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 501. *Meters*, 11. *Hydrants*, Mathews, 25. *Valves*, Eddy, Ludlow.

Consumption, 75,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 45 lbs.

Financial.—Cost, $60,000. Capital stock, $60,000. No debt. Ann. op. exp., $750. Ann. rev.: $4,400; city, $1,125. Hydrant rental, $45.

Management.—Prest., M. H. Mills. Secy. and Supt., Geo. C. Branch.

MOUNT VERNON, *Westchester Co.* (Pop., 4,586; est., 9,000.) In township of East Chester, between Bronx and Hutchison river, and is residence for New York City business men, being 15 miles from that city.

History.—Built in '86 by New York & Mount Vernon Water Co., under a 20 years franchise. Des. Engr., Geo. B. Inman, New York. Const. Engr., W. E. Allen. Contrs., Inman Bros., New York. In '83-4 an artesian well was sunk, a stand-pipe erected, and from these works water was furnished for domestic use.

Water Supply.—Hutchinson's creek, pumping from impounding reservoir to stand-pipe.

Reservoir.—Is 400 by 1,500 ft., by from 4 to 9 ft. deep; formed by excavating to gravel, and building a dam across valley of stream.

Dam.—At site of dam, valley was 440 ft. wide, and the ground consisted of about 2 ft. of muck, with 22 ft. of quicksand beneath. Sheet piling was driven through quicksand and into blue clay below, to prevent water from welling up through. A trench 4 ft. wide was dug through the muck, to quicksand, and filled with concrete; on this was built center wall 2 ft. thick at base, 1½ at top, reaching to within 1 ft. of top of embankment. The bank is 12 ft. high, 8 ft. wide on top, with outer slope 1½ to 1 and the inner slope of 2 to 1 paved 1 ft. deep. Waste-weir was built in body of dam, near end, leaving a clear space of 25 ft. for overflow, which is of masonry, 9 ft. thick at base, 5 at top, the top being 3 ft. below crest of dam. Underneath overflow is a 20-in. pipe, with valve, to be used in cleaning reservoir. It is proposed to raise the dam 3 ft.

Pumping Machinery.—Deane duplex compound condensing pump, dy. cap., 2,000,000 galls.; two 50 H. P. boilers built by Bigelow, New Haven, Conn.

Stand-Pipe.—Is 20 ft. in diam. and 100 ft. high; made by Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., miles not given. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 106. *Valves*, Ludlow. These items were finished in '87, and later figures cannot be obtained.

Financial.—Hydrant rental, $40. No further data given.

Management.—Prest., G. E. Taintor. Secy. and Treas., G. D. L'Huillier, 11 Wall St., New York. Supt., E. A. Sheaff.

NEWARK, *Wayne Co.* (Pop., 2,450; est., 5,000.) In Arcadia township; location of car shops of the New York, West Shore & Buffalo R. R.

History.—Built in '78 by Newark, New York, Water-Works Co. Engr., F. S. Pecke, Watertown. Contrs., Moffett, Hodgkins & Clarke, Watertown, who control the works. The company did pipe laying, put in foundations, and erected buildings.

Water Supply.—Springs, by pumping to stand-pipe from collecting reservoir.

Reservoir.—Capacity, 1,250,000 galls.

Pumping Machinery.—Two Worthington pumps, dy. cap., 2,000,000 galls.; two 80 H. P. return tubular steel boilers.

Stand-Pipe.—Steel, 20 by 80 ft., and made by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 20, time of report. *Meters*, 1. *Hydrants*, Ludlow, 71; one is at pumping station. *Valves*, Ludlow.

Consumption, 35,000 galls.: *Pressure*: Ordinary, 67 lbs. Fire, 140 lbs.

Financial.—Cost, $120,000. Capital stock, $100,000. Debt, $93,000. Int., 6%. Ann. rev.: city, $2,000. No further data given.

Management.—Prest., J. F. Moffett. Secy., C. T. Moffett.

NEW BERLIN, *Chenango Co.* (Pop., 937; est., 1,200.) On Unadilla river; has large tanneries and flouring mills.

History.—Built in '85 by village. Engr., W. F. Franklin. Contrs., Sherman & McDonough, Troy.

Water Supply.—Springs and brooks, by gravity from impounding reservoir.

Reservoir.—Cap., 14,000,000 galls.

Distribution.—*Mains*, w. i., 4 miles. *Services*, w. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*: Ordinary, 115 lbs. Fire, 115 lbs.

Financial.—Cost, $36,000. Bonded debt, $36,000. Int., 4%. Ann. op. exp., $50. Ann. rev.: consumers, $1,175; city, none.

Management.—Water Board. Prest. and Supt., G. G. Beers.

NEW BRIGHTON and PORT RICHMOND, *Richmond Co.* (Pop., New Brighton, 12,679; est., 16,000. Port Richmond, 3,561; est., 5,000.) On Staten Island, on shore of Kill Von Kull, on ground rising in terraces from water's edge. Population is largely made up of New York business men.

History.—Built in '81 by Staten Island Water Supply Co., whose system supplies both New Brighton and Port Richmond. Franchise for 5 years. Engr. and Contr., Jno. Lockwood, New York. Consulting Engr., Wm. J. Mc Alpine, New Brighton.

Water Supply.—Forty driven wells, which syphon into a large receiving well; by direct pumping and pumping to reservoir.

Pumping Machinery.—Combined dy. cap., 3,000,000 galls.; 1,000,000 and 2,000,000-gall. Knowles pumps.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 40 miles. *Services*, lead, galv. i. Pipe and specials, furnished by Mellert Foundry & Machine Co., Reading, Pa., and Donaldson Iron Co., Emaus, Pa. *Taps*, 1,840. *Meters*, 30. *Hydrants*, Eddy, first used, now using Jonson; 290 in '86. *Valves*, kind, do.

Consumption, 1,800,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Capital stock, $200,000. Bonded debt, $175,000. Int., 4 to 7%. Ann. op. exp., $16,000. Ann. rev.: about $40,000. Hydrant rental, $40.

Management.—Prest., Horace Brightman. Treas., H. L. Horton. Secy., J. T. Francis. Supt., J. Seymour Warde, West New Brighton.

NEWBURGH, *Orange Co.* (Pop., 18,049: est., 20,000.) On Hudson river: on steep slope of hill rising 300 ft. above river, with half of population less than 50 ft. above river. Engaged in hat, shoe, cotton, woolen, iron and other manufacturing, and boat-building. Incorp. a city in '65.

History.—Built in '53 by town.

Water Supply.—Washington lake and Silver creek, by gravity and pumping to reservoir. When full, Washington lake has an area of 140 acres, and is 276 ft. above the Hudson river. The drainage area of the lake is about 1 sq. m. In '74 Silver creek was connected with the lake by 1,864 ft. of 24-in. cement pipe and 168 ft., presumably, of open channel.

Conduits.—From lake 3,128 ft. of 24-in., and for the remaining distance 20-in., pipe leads to the city. From the natural outlet of the pond 15-in. cement, and 18-in. vitrified stoneware pipe extends 2,000 ft. to a natural subterranean passage, ¾ miles long, called the Swallow-hole, and ending in Trout-hole reservoir. From here, 15,200 ft. of 12-in. pipe connects with the other conduit at the city, and the two conduits are also connected near the reservoirs.

Reservoirs.—Trout-hole: 200 ft. sq., 44 ft. below lake and 232 ft. above Hudson. High Service; 55 ft. above Washington lake, 101 ft. above Trout-hole reservoir and 331 ft. above the Hudson; cap., 2,000,000 galls.

Pumping Machinery.—Worthington pump, dy. cap., 360,000 galls.

Distribution.—*Mains*, c. i., 32 miles. *Services*, lead. *Meters*, not given. *Hydrants*, Ayers. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure*: not given.

Financial.—Cost, $498,846. Debt, $292,500. Int., 3½ to 7%. Sinking fund, $78,300 Ann. op. exp., $11,000. Ann. rev.: consumers, $32,650; city, none.

Management.—Five Commrs. Supt. and Secy., Wm. C. Miller. Engr. to Board, Chas. Caldwell. Pumping Engr., Joseph Hampson.

NEW ROCHELLE, *Westchester Co.* (Pop., township, 5,276; est., village, 5,000.) Is 18 miles from New York.

History.—Built in '85-7 by New Rochelle Water Co. Des. Engr., J. J. R. Croes, New York. Const. Engr., Chas. W. Hunt, New Rochelle.

Water Supply.—Hutchinson's river, by gravity from impounding reservoir.

Reservoir.—Covers 32 acres, and has cap. of 100,000,000 galls. Contr. for masonry and foundations, Wm. F. McCabe, Mamaroneck.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J., and pipe laid by R. Dooley and Molloy Bros., New Rochelle. *Taps*, 130. *Meters*, 120. *Hydrants*, Galvin, 73. *Valves*, Ludlow. *Pressure recording gauge*, Edson.

Consumption, 20,000 galls. *Pressure*: Ordinary, 30 to 70 lbs. Fire, do.

Financial.—Cost, $290,000. Capital stock, $80,000. Bonded debt, $210,000. Int., not given. Ann. rev.: city, $2,100. Hydrant rental, $30 each for 70. Other data not yet determined.

Management.—Prest., Adrian Iselin. Engr. and Genl. Mgr., Chas. W. Hunt.

NEW YORK, *New York Co.* (Pop., 1,206,209: est., 1,700,000.) Occupies a tract about 2 miles wide and 16 long, its southern extremity, from Battery Park to Grand St., being a triangle 1½ miles long with a base of two miles. From Grand street north, 7 miles to Harlem, the city lies between the Hudson and East rivers. At Harlem the Harlem river flows diagonally across the city to Spuyten Duyvil, on the Hudson, 13 miles from the Battery. Northwardly from Harlem the city is about three miles wide, and is bounded on the east for 8 miles by the Bronx river, a small fresh water stream. The lower portion of the city slopes each way to the rivers from Broadway, which is the axis of the city. In the first mile from the Battery the ground rises about 40 ft.

and continues at nearly that elevation for three miles further, or to 30th street. There are 20 streets to a mile. From 30th to 80th street the elevation increases from 50 to 80 ft., from 80th to 125th street, it is from 80 to 120 ft. on the west side the east side being lower. Above 130th street and west of the Harlem river, the ground is from 150 to 200 ft. high. North of the Harlem river the ground is irregular, varying in height from 10 to 280 ft.

History.—In 1744, the population being 22,000, and comprised within two miles of the Battery, Cristopher Collis, a civil engineer, constructed by order of the Common Council, a reservoir east of Broadway, 1½ miles from the Battery, and sunk a large well on the bank of the Collect, a stream near by. The work was stopped by the Revolutionary War.

In 1799, the population being 60,000, the city subscribed for 2,000 shares of the Manhattan Co.'s stock, a corporation organized for banking and supplying water. This company constructed a well 25 ft. in diam. and 30 ft. deep, near the Collect, in what is now Centre, between Reade and Duane streets. Water was pumped to a reservoir on Chambers street by two 18 H. P. steam engines. In '23, there were 25 miles of distribution pipe of bored logs, the engines were working 16 hours a day, and raising 691,200 galls., one-fifth more than the capacity of the reservoirs; 2,000 houses and several manufactories were supplied, but the population had increased to 150,000. Between '30 and '32 the company sunk a well, corner of Broadway and Bleecker streets, 8 in. in diam. and 442 ft. deep, through rock. Water rose to within 29 ft. of the surface, and 44,000 galls. were pumped daily by a 6 H P. engine.

In '30 the city built works for the Fire Department, consisting of a well at 13th street, near Broadway, 16 ft. in diam., 112 ft. deep. 97 ft. being through rock. At 12 ft. from bottom, two lateral galleries were run out, each 4 by 6 ft. and 75 ft. long, one having a branch 25 ft. long. Water rose in the well to within 12 ft of the surface, which was 50 ft above tide. A 12 H. P. engine pumped the water into an iron tank 44 ft. in diam. and 20.5 high, with bottom 83.5 ft. above tide. The engines could run only three hours twice a week, before exhausting the supply, making an average daily yield of 10,428 galls. Before the lateral galleries were run the water was very soft, afterwards very hard. The cost of the works to Dec., '32, was $42,233. A line of 12-in. cast-iron pipe was laid from this tank down Third avenue and the Bowery to William street, with 10 and 6 in branches in cross streets, in all, 34,726 ft. at a cost of $70,950. The supply of water at this time was so limited that 600 hogsheads were brought in from wells in the country, and sold at an average price of $1.25, and 415 hogsheads were sent daily from Brooklyn to supply shipping, at a cost of $160. Hotels paid from $200 to $450, yearly and boarding-houses from $15 to $50 for well water. In '34 the daily yield of the 13th street well was increased to 21,000 galls., by boring in its bottom a 2½ in. hole, 100 ft. deep. About this time a well was dug near Jefferson Market 16 ft. in diam. by 30 ft. deep, from which an 8 H. P. engine with 7-in. pumps, forced water ¼ mile to the 13th street tank.

In Feb., '35 the Common Council had laid for fire service from the tank, 74,888 ft. of 12, 10 and 6-in cast-iron pipe, had put in 61 stop-cocks, 176 fire hydrants, and 344 branches, at a total cost of $182,851, of which $162,636 was for material, and $20,215 for labor.

Mar. 11, '35, Major D. B. Douglas' plan for procuring water from the Croton river was adopted by the Common Council and afterwards ratified by a popular vote of 17,330 to 5,963.

The work on the Croton Aqueduct was soon begun, and water passed through it June 27, '42. This was the first efficient general water supply introduced in New York City, the population then being about 375,000. The route of the aqueduct was located and the plans for it made, by Major David B. Douglas, who was Chf. Engr. till Oct., '36, when he was succeeded by Jno. B. Jervis, who completed the work after the general design, but with modification of detail.

Sept. 4, '84, an additional supply of water was introduced from the Bronx river, supplying the upper part of the city, the 23rd and 24th wards, the surplus passing on to the receiving reservoirs below. This work was done under the direction of Geo. W. Birdsall, who was Acting Chf. Engr. of the Croton Aqueduct from Oct. '78 to Oct. '80, and then Asst. Chf. Engr. until his appointment as Chf. Engr.

In '83 the State Legislature passed an act to provide new reservoirs, dams, and a new aqueduct and appointed an Aqueduct Commission for the purpose of providing an increased water supply for the City of New York. Aug. 15, '83, Benj.

S. Church, who for 26 years had been Resident Engineer in charge of the Croton Aqueduct, was appointed Chief Engr. of the Aqueduct Commission, and later, Jos. P. Davis, Consulting, Alphonso Fteley, Principal Assistant and Henry S. Craven, Const. Engrs. Apr. 9, '84 final plans for the route of the new aqueduct were adopted, and Dec. 13, '84, the contracts for the construction of the portion between the Croton and Harlem rivers were awarded: sections A and B to Heman Clark; 6, 7, 8 and 9 to O'Brien & Clark; and 2, 3, 4 and 5 to Brown, Howard & Co.; and in '88 O'Brien & Clark were given the contract for the pipe line between 135th Street and Central Park, connecting the masonry conduit with the receiving and distributing reservoir. Ground for the construction of the Aqueduct was broken Dec. 30, '84. A description of the new aqueduct and reservoirs, and the progress of the work, will be given further on.

The original works were built under a Commission appointed by the Legislature, and from '42 to '49 were managed by a board appointed by the Common Council. In '49 the Croton Aqueduct Board was formed. It consisted of three commissioners, one of whom was an engineer, appointed by the mayor and aldermen, and holding office five years. From July '49 to May, '68, Alfred W. Craven was Chf. Engr. and Commissioner. He was succeeded by Gen. Geo. S. Greene, who held the office till '70, when the Croton Aqueduct Board was abolished and its powers transferred to a Commissioner of Public Works, who appointed as the first Chf. Engr., Edw. H. Tracy, who served until his death in '75, when Jno. C. Campbell was appointed. Owing to some trouble regarding the appointment, Geo. W. Birdsall was Actg. Chf. Engr. from Oct., '78 to Oct., 80, when Mr. Campbell resumed his position and continued until Mar. 15, '81. His successor was Isaac Newton, to whom the city is largely indebted for the plans adopted for the new aqueduct. Since Mr. Newton's death, in '84, Geo. W. Birdsall has been Chf. Engr. of the old Croton Aqueduct, while Benj. S. Church has been Chf. Engr. of the new Aqueduct Commission since its organization. In planning the new aqueduct Mr. Newton was assisted by the Consulting Engr. of his department, E. S. Chesbrough, who built the Cochituate Aqueduct for Boston, and the Chicago tunnels; by Benj. S. Church, and Julius W. Adams. The plans were submitted to and approved by, Jno. B. Jervis, who designed and built the old Croton Aqueduct, to Jas. B. Francis, who conducted the famous Lowell hydraulic experiments, and to Robt. K. Martin, who built the Baltimore Aqueduct tunnel and water-works. These gentlemen, and Gen. Geo. S. Greene, former Chf. Engr. of the old Croton Aqueduct, and constructor of the large reservoir in Central Park and the Boyd's Corner Reservoir, also examined the question of storage and concurred in Chf. Engr. Newton's report on this subject.

Water Supply.—Croton and Bronx rivers, by gravity from storage and impounding to receiving and distributing reservoirs; for the high-service supply, 6,000,000 galls. is pumped daily to reservoir, and 8,000,000 galls. to stand pipe.

Croton Supply: The Croton river has a drainage area of 338.82 sq. m. above the Croton dam, from which the aqueduct starts. Its southern limit is 40 miles from the Battery, its average length is 25 miles, width 13.5 miles. At point where water is taken the valley of main stream is 120 ft. above tide-water, and rises to 450 ft. at head waters, while the tributary streams rise from 300 to 600 ft., and the surrounding hills from 400 to 1,000 ft., above tide. The surface of the drainage area is broken and rocky, the rock being Laurentian gneiss, and a large part of the area is wooded. The minimum observed natural daily flow of the river, to '80, was recorded by Horatio Allen, Aug. 16, '38, as 31,663,872 galls., or 0.126 cu. ft. per second per sq. m. of drainage area. The maximum observed daily discharge was in Apr., '84, and is estimated at about 19,000 millions galls., or exactly 74.87 cu. ft. per second per sq. m.

In '84 it was stated that the daily flow over the Croton dam varied from 10,000,000 to above 8,000,000,000 galls. The daily consumption then being about 100,000,000 galls. the necessity for the storage reservoirs is obvious.

Bronx Supply; The river has a drainage area of 13 sq. m. above the reservoir at Kensico. There are two storage reservoirs for this supply, Dry pond and the Kensico. Water is conveyed from the latter 15.2 miles to the distributing reservoir at Williamsbridge, in the upper part of the city.

Dams and Storage Reservoirs.—*Croton River Dam and Lake:* At head of aqueduct, first built with 90 ft. masonry overfall, the rest being earth embankment. Jan. 7, ,41, a freshet occurred, overflowing and carrying away the earth embankment. When rebuilt the overfall of the dam was made 270 ft. long. The foundation is two lines of cribs, filled with dry stone, with 10 ft. of concrete between. Upon this, broken range stone masonry was laid, the down-stream side being curved, and faced with granite, and the whole backed with earth. Below, a small crib dam, with planked apron, forms a basin serving as a water cushion to break the shock of the falling water. The dam is 40 ft. high, its top is 166 ft. above tide-water, and it forms Croton lake, of 400 acres area and 500,000,000 galls. capacity above the level at which the aqueduct would discharge 35,000,000 galls. daily. The cost of this part of the work was about $9,000,000.

Boyd's Corner Dam and Reservoir: cap., 2,727,000,000 galls. Built in '66-72, 23 miles from Croton dam, on west branch. Has cut stone faces filled between with concrete. Up-stream face is vertical, and down-stream face batters 4 ft. in 10. Extreme height from rock foundation is 78 ft., its top is 8.6 ft. wide, by 670 ft. long. Waste-water is carried off through a bye-wash, 135 ft. long, cut in the rock at end of dam. In '70 an earth embankment was added on up-stream side. Des. Engr., Geo. S. Greene.

Middle Branch Dam and Reservoir; Cap., 4,004,000,000 galls. Built in '74-8, on Middle branch of Croton. Is of earth, with center of rubble masonry carried to rock bottom. Overflow is through channel cut in rock, and water is drawn out through rock tunnel driven around end of dam. Des. Engr., E. H. Tracy.

Other Storage Basins, natural and artificial, with capacities in millions of galls., are: East Branch, 4,500; Lake Mahopac, 575; Lake Kirk, 565; Lake Gleneida, 165; Lake Gilead, 380; Lake Waccabuc, 200; Lake Tonetta, 50; Barrett's pond, 170; China pond, 105; White pond, 100; Pine pond, 75; Long pond, 60; Peach pond, 230; Cross pond, 110; Haines pond, 125; making with the Boyd's Corners and Middle branch reservoirs a total storage capacity (in) the Croton drainage area of 14,000,000,000 galls.

Bronx System of Storage Reservoirs: Dry Pond covers 300 acres, is 16 ft. deep, and has cap. of 1,200,000,000 galls. Kensico Reservoir covers 275 acres, is 30 ft. deep, and has cap. of 1,600,000,000 galls. Water was first drawn from this in '84. As originally designed the dam was to be 45 ft. high and flood 250 acres at an elevation of 200 ft. above tide water, and with a capacity of 100,000,000 galls.

Croton Aqueduct.—From dam at Croton lake to receiving reservoirs in Central Park. Masonry, brick-lined, the bottom being an inverted arch of 6.75 ft. chord, and 0.75 ft. versed sine; sides, 4 ft. high, battered to 7.42 ft. apart, at top, and covered with a semicircular arch. Interior is 8.64 ft. high, and has area of 58.34 sq. ft. Foundation is of concrete, side walls and sprandrel backing of rubble masonry. Sectional area of masonry is 42.525 sq. ft. Top of masonry is 4 ft. underground. Embankments were built 8 ft. wide on top, slopes 1½ to 1, with wall of dry stone rubble built up from natural surface to foundation level; high embankments had retaining walls of dry stone below spring of arch. This dry stone foundation settled, causing longitudinal cracks to appear from time to time, some of them being quite large.

From '63-9 the total length of cracks repaired was 34,271 ft. The length of the aqueduct is 38.1 miles, and the total fall 43.7 ft., the ordinary grade being 1.1088 ft. a mile. Two deep valleys are crossed by the aqueduct, the Harlem river and Manhattan.

Harlem River Crossing: On Granite masonry arched bridge, with length between gate-houses of 1,393.38 ft., and elevation in the clear of 100 ft. To save an estimated extra expense of $500,000 the bridge was placed at exactly the height required by law, 100 ft., and carried water across in two 36-in. pipes, 11 ft. lower than the grade of the aqueduct, with a fall of 2.34 ft. It was supposed that these pipes would be large enough for 50 years, but in '60 it became necessary to increase the capacity of this part of the aqueduct. On the floor of the bridge, cast-iron standards were erected, 12 ft. apart, longitudinally, with planed tops 2½ ft. sq., upon which were three cast-iron rollers, turned true, bearing cast-iron saddles, the base of each being 2½ ft. sq., planed. The saddles carried a wrought-iron pipe, 7 ft. 6½ in. in diameter, formed of plates ½ in. thick, 6 ft. long, and 8 ft. wide before bending. The joints planed to radial lines, and covered with ½ by 9-in. straps having four rows of ¾-in. rivets, which were counter-sunk to the interior surface of the pipe. Built into and connecting each end of the pipe with the gate-houses is a slip joint, the moving surfaces of which are faced with brass.

The temperature of the water varying 50° between winter and summer, the pipe contracts and expands about 6 in. The large pipe is kept painted inside and out. For protection from the weather and convenience in crossing, the pipe was covered over in such a way as to make a roof and a footway. The chamber in which the pipes are laid is 14 ft. square, lighted from above. The capacity of the three pipes equals that of the masonry part of the aqueduct. Gen. Geo. S. Greene was the Des. Engr.

Manhattan Valley Crossing: Two miles long, first of two 36-in. pipes, to which was added a 48-in. pipe in '53 and a 60-in. pipe in '61, the latter being the largest iron pipe cast up to that time. The pipes were straight cylinders; joints were cast-iron half sleeves, flanged and bolted.

Branch of Aqueduct and Changes: In '61 a branch was built from 92d street to the new reservoir, and in '65 the portion below 92d street was replaced by two lines of 72-in. cast-iron pipe, laid along the streets. Of 486 lengths laid, 20 cracked soon after water was let in, generally at the hub. A great number have broken since and have been repaired by banding them with wrought-iron straps. From '70-5 ¾ miles of masonry aqueduct within the city was replaced by six lines of 48-in. pipe laid along the streets. The utmost safe daily capacity of the Croton Aqueduct has been called from 95- to 98,000,000 galls.

Bronx River Conduit.—From Kensico or collecting reservoir, on river, to distributing reservoir at Williamsbridge; 15½ miles of 48-in. pipe, and also 2½ miles of 36 in. pipe around receiving reservoir and to Jerome avenue.

Receiving and Distributing Reservoirs—*Central Park, Old*: Built before '40, is 6 miles from Battery, 836 by 1,826 ft., and 20 ft. deep, with a cap. of 150,000,000 galls. Its interior slopes are lined with a dry stone wall.

Central Park, New: Built in '58-62, adjoining the old one, with water area of 96 acres, and 36 ft. deep, with a cap. of 1,200,000,000 galls. Its outline is irregular, being adjusted to the topography. Banks are of earth, slopes 1½ to 1, with center puddle wall extending from rock foundation 2 ft. above high-water level. In soft or disintegrated rock a trench was excavated to solid material, filled with concrete, which was carried a few feet above bottom of puddle to form a core. Inner slope of embankment is faced with 8 in. of concrete on which is an 18-in. paving of large stone laid in cement. This reservoir is also in two divisions, either one of which can be used alone. Influent and effluent gate-houses are of granite masonry, the chamber in the latter being separated from the pipe-vault by a 6-ft. concrete wall, faced with brick. This wall leaking, the reservoir was emptied, the wall dried, washed with a solution of castile soap, followed by one of alum. Four coats were applied, and the wall has not leaked since.

Williamsbridge Reservoir.—Receives Bronx river supply and distributes it to the extreme upper part of the city. Is being enlarged to a cap. of 140,000,000 galls., when it will cover 15 acres and be 40 ft. deep.

Murray Hill Distributing Reservoir.—Built for a distributing reservoir. Has a cap., 24,000,000, and is 400 ft. sq. at water surface. Exterior walls are of cut stone masonry, double, connected by arches. An earthen embankment is placed against inner face, on which a stone paving is laid.

Pumping Machinery.—At High Bridge the pumping engines were designed by Wm. E. Worthen, New York, and had a dy. cap. of 5,000,000 galls. each. One was erected in '70 and one in '76. At Central Park there are two Worthington pumping engines, built in '79-80; combined dy. cap., 15,000,000 galls.

High Service Supply Reservoir.—Built at High Bridge in '66; has cap. of 10,794,000 galls., depth of 16 ft., and flow-line 216.6 ft. above tide-level. Its banks are of earth with inner slopes paved with stone laid in cement. Connected with the reservoir is an iron stand-pipe and tank containing 47,000 galls., and enclosed in an ornamental masonry tower the flow line being 324 ft. above tide-level. There is another stand-pipe at 98th street, 6 ft. in diam. and 152 ft. high, the base being 75 ft. above tide.

A pumping station at High Bridge supplies the reservoir and stand-pipe from the aqueduct, and another at 98th street the stand-pipe there.

Islands in the East River, on which are penal and charitable institutions, are supplied through submerged pipe. Randall's and Ward's islands were first supplied in '46 through two 3, and one 3¼-in. lead pipe, laid in wooden trunks on the bottom of the river. In '50 a flexible gutta percha pipe was laid across the irregular bottom of the river to Blackwell's island. In '52, '61 and 70 these pipes were broken and replaced, the latter time by 3-in. wrought iron pipes. In '71 these were broken and replaced by one 6-in. lap-welded wrought iron pipe, the joints made with heavy screen couplings, and strengthened by cast-iron sleeves with leaded joints. The pipe was 1,350 ft. long, was put together on land, inclosed in a bolted and riveted oak case, the space around the pipe filled with cement, the box saturated with coal tar, and hauled across the river into place by chains from a steam capstan. The pipe and box weighed 200 tons, and were laid in 100 ft. of water. Similar pipes were laid to Ward's island in '74, to Randall's island in '76 and a 10-in. pipe across the Harlem river to the annexed district, in '74. In '69 an 8-in. pipe, lined with 1-in. of wood to prevent water in the pipe from freezing, had been laid to Randall's island. The breaks in the gutta percha pipe were caused by the giving away of anchors, allowing the pipe to move back and forth on the rough bottom till worn out and by the dragging of ship's anchors, tearing the pipes apart.

Distribution.—*Mains*, c. i., 620 miles. *Services*, w. i., lead. *Taps*, 180,000. *Meters*, 18,000; Worthington, Crown, Thompson. *Hydrants*, Ayres, 7,984.

Consumption, 110,000,000 galls. *Pressure*: Ordinary, 10 lbs. Fire, 20 lbs. *Pressure gauge*, Edson.

Financial.—Cost, $40,000,000. The total expenses for the Croton Water supply from '42 to Jan. 1,1884, had been $43,793,663.47, and the revenue $14,051,697.50. Later figures and debt not given. Ann. op. exp., $600,000. Ann. rev.: consumers, $2,695,000.

Management.—Commr. of Public Works, Gen. Jno. Newton. Chf. Engr., Geo. W. Birdsall. Water Purveyor, A. G. Culver. Registrar, J. H. Chambers.

The New Croton Aqueduct.—The line for the new aqueduct as adopted Apr. 9 '84, begins at Croton Dam on Croton river, and runs south along Pocantico and Saw Mill river valleys, across Harlem river to north side of Manhattan valley at 135th street. Harlem river to be crossed by inverted syphon, and water to be conveyed in pipes from 135th street to reservoir in Central Park. The elevation at Croton river will be 146 ft. above tide level. The total length from Croton Dam to Central Park Reservoir will be 33½ miles, and the fall, 33.8 ft. For the first 24 miles the interior of the conduit is to have a cross-sectional area such that its flowing capacity will be equal to that of a circular conduit 14 ft. in diam. At this point the conduit begins to be on a hydraulic grade, so its area is reduced to equal a circular conduit 12¾ ft. in diam., and at north side of Harlem river, the conduit will be reduced to equal a circular conduit 10½ ft. in diam. The latter reduction is on account of taking out from 80,000,000 to 100,000,000 galls. to supply the 23d and 24th wards from a distributing reservoir at or near Jerome Park. The cross-section of the conduit varies according to location, pressure and material through which it passes.

Four waste-weir gate-house have been located, the first at Pocantico river near Tarrytown, 9½ miles south of the beginning of the conduit; the second at Saw Mill river, 6¼ miles further south, near Ardsley; the third at Tibbett's brook, 5½ miles below the second, and the fourth at Harlem river. There will be three gate-houses for controlling and regulating the water supply through the aqueduct, one each at Croton dam, 135th street, and Central Park.

Shafts are located along the line from 6,200 to 7,800 ft. apart. In its length from Croton lake to Harlem the tunnel grade twice reaches the level of the ground, and these points constitute open portals, numbered as shafts, that at Pocantico being No. 9, and at Tibbett's brook, No. 18. At Ardsley the tunnel is near enough the surface to discharge its contents, if desired, through a culvert, and at High bridge it can be emptied into Harlem river, far below ground, through an audit tunnel. At these four points the waste-weirs, described above, are located.

In connection with the construction of the new aqueduct it was deemed necessary to build three new dams and storage reservoirs, known as the Quaker Bridge, Muscoot and Sodom.

Dec. 23, '85, the Commission resolved to build the Sodom dam, on the East branch of the Croton river. The final design for the Quaker Bridge Dam has not yet been determined upon. A board of experts were appointed the earlier part of '88 to consider and report upon the plans for this structure, as projected by the engineers of the Commission. The final board was Jos. P. Davis, J. J. R. Croes and Wm. F. Shunk. No report had been made up to July 1, '88.

To '88, bonds to the amount of $16,383,337 had been issued to meet the expenses for the new aqueduct. To the same date, 35 shafts, with a total depth of 4,491.42 ft. had been completed; the greatest depth of shaft being 350.026 ft., and the least depth 28.224. There had also been excavated 21.696 miles of tunnel, and 0.964 miles of open cut, making a total of 22.66 miles of completed excavation, and leaving 8.201 unexcavated. Of the masonry lining, 16,713 lin. ft. of the arch, 32,382 lin. ft. of the east wall, 31,881 lin. ft. of the west wall, and 7,722 lin. ft. of the invert arch had been completed. At the Croton gate-house 7,031 cu. yds. of earth and 51,619 cu. yds. of rock, total, 58,565 cu. yds., had been excavated.

Further details will be given in future issues of the MANUAL.

References.—These sources of information give detailed historical, descriptive and statistical accounts of nearly every phase of the water supply of New York City.

"The Croton Aqueduct." From "A Memoir of American Engineering," by Jno. B. Jervis. Descriptive. Trans. Am. Soc. C. E., vol. II., pp. 54-60.

"Memoir of the Construction of a Masonry Dam." With two plates of sections and elevations of the dam. By J. J. R. Croes. Detailed description of dam on a branch of the Croton river, and its construction. Trans. Am. Soc. C. E., vol. III., pp. 338 67. Reprinted in *Eng. News*, vol. III., pp. 114-15, 122-3, 130-1.

"Notes on the Flow of the West Branch of the Croton River." With a large diagram and four tables. By J. J. R. Croes. Trans. Am. Soc. C. E., vol. VI., pp. 76-86 and erratum on p. VI.

"Description of a Line of Large Water-Mains, laid by the Croton Aqueduct Department of the City of New York; and an Inquiry into the Causes of Failure of a few of them." Illustrated by a plan of two lines of 6-ft. pipe, with section of pipe and details of sleeves used in repairing. By A. A. Craven. Trans. Am. Soc. C. E., vol. I., pp. 3-11.

„ Notes and Suggestions on the Croton Water-Works, and Supply for the Future." With cut showing section of aqueduct and embankment. By B. S. Church, with discussion following. Read and discussed Feby. 2, '76. A comprehensive treatment of the subject for the time, giving many practical deductions and hints. Trans. Am. Soc. C. E., vol., V., pp. 107-14, errata, 214, and discussions, 254-75. Also reprinted in *Eng. News*, vol. IV., p. 28.

"The Gauging of Streams." With tables and diagrams showing the number of cubic feet of water discharged per second per sq. mile of drainage area in the Croton, Sudbury, Concord, Merrimac and Connecticut rivers. By Clemens Herschel. Trans. Am. Soc. C. E., vol. VII., pp. 236-42.

"Report to the Aqueduct Commissioners, by the President, Jas. C. Spencer. Containing Reports of the Secretary, Jno. C. Sheehan, and of the Chief Engineer, Benjamin S. Church, and giving a review of the Aqueduct Commission to Jan. 1, '87, including the plans and work of construction of the New Croton Aqueduct to that date, and the Proposed Dams and Reservoirs and other Appurtenances of the same, made in accordance with the resolution of the Aqueduct Commissioners." This book has 63 pp. of text, many tables, profiles, and diagrams, and numerous fine illustrations from photographs taken along the line of work; also profile showing monthly progress of work, and maps and drawings showing plan of works and details of construction. Size, 11½ by 14 ins., 1½ ins. thick. Printed and published under direction of Commissioners, by Douglas Taylor, New York. Jan. 1, 1887.

The following references are to volumes and pages of *Engineering News*:

High Service, Croton	7	135
History and Statistics. Croes'	8	91 101
History from 1774	8	449
How Croton Water is Wasted	8 11	450 306
Jersey City Scheme for	11	54 78
Lake George Scheme.		
Bill Introduced	9	80
Report on	9	104
Changes in Bill	9	129
Reported in Senate	9	178
Fanning's Report, No. 2	13	58
Masonry Dam. Constr'n of a	3	114
Metropolitan Company	14	24
Protection of the Dry Goods District	15	89
Ramapo Scheme. The	10 11 13	223 237 631 18 334
Rates	9	182
Streets and	10	16
Union League and N. Y. & W. Sup	9	128
N. Y. & Hudson Valley Ry. Co.	18	293

The New Croton Aqueduct.

Proposed Increase of N. Y. W. Sup.	3	41
Notes and Suggestions for Future Sup	4	28
Surveys and Proposed Plans for Additional Sup	5	255
Maps, Estimates and Descriptions of Proposed Additional Sup.	7	296
Protest of Union League Club against	8	209
Veto by Gov. Cornell of.	8	280
General Description of Proposed.	9	56
Comparative Estimates	9	72
Mayor Edson Appoints a Com. of Five	10	35
Report of Mayor Edson's Com. on	10	128
Bill passed. Com.'s apppointed May 3, '83	10	214
Adoption of Plan	10	294
Com. Organized. Election of Officers	10	322
Meeting of Aug. 8. Com. Thompson's Rep	10	379
The Engrs. who Designed the System	10	390
B.S.Church appointed Chf.Engr	10	406
Map of Watershed and Proposed Line	10	405
Board Meeting Sept. 11. Quaker Bridge Dam discussed and additional Aqueduct Plans presented	10	430
Board meeting Oct. 13. Saw Mill Route Survey	10	498
Opposition to Hudson River Route	10	550
New Line Proposed by Chf. Engr. Church	10	630
Adoption of Modified Route	10	635
Size and Terminus of the	11	1[illegible]8
Mayor Edson on the Delay in Commencing	11	30
Appointment for Jos. P. Davis and A. Fteley as Consulting and Executive Engrs.	11	91
Commrs. visit Baltimore and Washington	11	127
Estimated Cost of the.	11	130
Specifications and Plans of Quaker Bridge Dam	11	171 173 174
Public Hearing Closed. Route Adopted	11	177
Maps and Plans Adopted and Signed	11	203
Maps and Plans filed with Reg-	11	305
Raising the Grade 10 feet.	12	36
Death of Isaac Newton	12	150
Proposals for Sect. A and B advertised	12	191
Details of Bids for Sect. A and B	12	215
Table of Aggregate Bids. All rejected	12	234
Description and History with Map, Profile and General Plans.	12	270
New Bids for Sect. A and B	12	286
Details of Bids opened Dec. 8, '84	12	288
Award of Contracts and Accounts	12	292
Tables of Details of Bids opened Dec. 8, '84	12	300
Ground Broken Dec. 30, '84	13	8
Official Organization of the Com	13	10
Sureties of Contractors.	13	10
Meeting of Jan. 7. Construction commenced. Civil Service Rules for appointments	13	24
Bonds Issued for Expenses for 6 mos	13	45
Appointments on Engr. Corps.	13	90
Specifications for Section 9.	13	148 161
Typical Tunnel Cross Section.	13	152
General Plan and Section of Shaft.	13	162
Cross Section in Piles and Flooring	13	163
Tunneling Plant	13	168
Table of Prices	13	191
Removal of Offices to Stewart Building.	13	298
Legal Opinion on Sinking new Shafts	14	61
Award of Cont. for Sect. 1	14	93
Details of Bids at Gate House.	14	95
Tunnel Plant and Progress on Brown, Howard & Co.'s Cont.	14	200
Accidents and Deaths.	14	296 302 377
Quaker Bridge Dam	14	315
Progress Report to Nov. 7	14	328
O. B. Potter's Opposition to Quaker Bridge Dam	14	360
Tunneling Gould's Swamp	14	379
Rules for Protecting Employés.	14	379
Bonds Issued for Construction.	14	379
Tables Showing Progress in all the Shafts	14	394
Profile, Plans and Sections of Sect. 12, 13, 14	15	20
Rules and Regulations. Wages.	15	31
Experts on the Quaker Bridge Dam.	15	41
Progress on Brown, Howard & Co.'s Contract	15	55
Bids on Sects. 12, 13, 14 opened Jan. 29, '86	15	63
Awards of Contracts	15	79
Official List of Officers and Subordinates	25	90
Union League Club and Quaker Bridge Dam	15	93
Rattler and Dynamic Drills	15	96
Construction of the Sodom Dam	15	110
Report on Quaker Bridge Dam and Reservoir.		
B. S. Church	15	119
G. W. Birdsall and J. W. Adams		129
Editoral Notes on.		136
Public Hearing Extended to April 1	15	142
Chf. Engr. Church *vs.* Engr. Craven	15	152
Increasing the Number of Commrs	15	191 312
The Ingersoll Rock Drill.	15	217
Appointment of Special Police.	15	334
Ventilation of	15	344 363 394
First Meeting of Tunnels	16	16
Reorganization of Eng. Corps.	16	57
A. Fteley appointed Consulting Engr.	16	57
Resignation of Jos. P. Davis, Consulting Engr.	16	57
Fast Tunnel Driving Rand Drills	16	63
"Freeze Out" of Secy. McCulloh	16	72
Death of H. O. Thompson	16	75
Bids for Crib Docks	16	79
Div. of Line into 5 Engr'g Divs.	16	88
Indictment of R. M. Squire and M. B. Flynn	16	104
Preparatory Work on Plans	16	106
Death of E. S. Chesboro, Consulting Eng.	16	120
Total Cost to Aug., '86	16	127
Dismissal of Comm. Squire	16	136
Appointment of Gen'l Jno. Newton	16	136

The Safety Line in using Surface water	16	156
Creation of Office of Asst. Chf. Engr	16	184
Comm. Barnes appointed Chairman	16	185
Change of line of N. Y. & N. E. R. R., in croton valley, proposed	17	30
Ventilation, Forty New Inspectors	17	94
Rapid driving in Aq. Tunnel, shafts 15 and 19 North	17	101
Bids for Gate House, Sect. 15	17	132
Meeting of Shafts 19½ and 20	17	93 133
Quaker Bridge Dam	17	101 126 341
Extra Excavation and back filling	17	277
Accident at Shaft	17	105 141 197 363 404
Loose Material at Shaft 17	18	109
Work at shaft 17	18	109
Estimates for '88	18	377
Extra for Contrs	18	377 467 476
Fast Tunnelling on	18	100 123
Harlem River Tunnel	18	305
Meeting of Shafts 2 and 3	18	359 377
Progress on	18	82 366
Rept. of Com	18	113
Time Extension	18	197
Quaker Bridge Dam	18	458
Extra claims for excavation	19	16
Contracts ready in Jan., '88	19	37
Table showing meeeting of headings	19	38
Amount of Bonds issued to '88	10	73
Contract for pipe and pipe laying-135th street to Central Park, let to O'Brien & Clark	19	173 427
To Experiment on resistance of brick	19	243
Investigation of Com	10	351 884 505
Proposed Com. Rept for '87-8	19	499
Quaker Bridge Dam	19	81 139
Design of illust.		163 187
Experts to report on		272 593
Jos. P. Davis, J. J. R. Croes		178 243
Hermann Shuster		372 527
High Masonry Dams of the world—from Chf. Engr. Church's and Consulting Engr. Fteley's Rept.	19	15 20 74 92

NEW YORK MILLS, *Oneida Co.* (Pop., 902.)

No official returns have yet been given for '88, but it is reported that an individual, or company, operates a direct pumping system of works, with 23 hydrants.

NIAGARA FALLS, *Niagara Co.* (Pop., 3,320; est., 5,000.) On Niagara river, adjoining the Falls, village being on level ground. Summer resort, and has several manufactories. Settled in 1759; incorp. in '48.

History.—Built in '77 by Niagara Falls Water-Works Co. Engr., Ben. J. Rhodes.

Water Supply.—From Suspension Bridge water-works.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 471. *Meters*, none. *Hydrants*, kind not given, 56.

Consumption, 500,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 120 lbs.

Financial.—Cost, $48,153. Debt, none. Ann. op. exp., $5,467. Ann. rev.: consumers, $6,053; city, $2,800. Suspension Bridge receives 40% of gross receipts.

Management.—Prest., S. Pettebone. Secy., Ben. J. Rhodes.

NORWICH, *Chenango Co.* (Pop., 4,553; est., 5,500.) On Chenango river, at mouth of Cemasawacta creek. Two high ridges are separated by the Chenango valley, one rising 500 ft. Engaged in manufacturing. Settled in 1788; incorp. in '16.

History.—Built in '81 by Norwich Water-Works Co. Engr., P. H. Baermann, Troy.

Water Supply.—Hopkin's brook, with four miles drainage area, by gravity from impounding reservoir.

Reservoir and Dam.—Cap., 30,000,000 galls.: reservoir is 35 ft. deep, 180 ft. above village, and is formed by earth dam 40 ft. high, 10 ft. wide on top, 323 ft. long, with puddle wall in center, and cross walls of concrete at base of puddle.

Filter and Conduit.—Water is drawn from the reservoir through a 24-in. vertical pipe, with drain tile at base for filter, and is conveyed thence to village by 8,200 ft. of cast-iron pipe.

Distribution.—*Mains*, c. i., 9.5 miles. *Services*, w. i. *Taps*, 350. *Hydrants*, kind not given, 27. *Pressure gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 73 lbs. Fire, 73 lbs.

Financial.—Cost, $100,000. Capital stock, $50,000. No bonds. Debt, $15,000. Int., 5%. Ann. op. exp., not given. Ann. rev: consumers, est., $6,000; city, $972. Hydrant rental, $36.

Management.—Prest., Jno. Michell. Secy., T. DeWitt Miller. Treas., Cyrus B. Martin. Trustees act as Supt.

NUNDA, *Livingston Co.* (Pop., 1,037; est., 1,200.) Has machine shops, foundries, furniture and wagon factories.

History.—Built in '86-7 by Nunda Water Co.

Water Supply.—Springs, by gravity, and pumping to reservoir for reserve.

Distribution.—*Mains*, Wyckoff wood. *Hydrants*, 25. *Pressure*: Fire, 75 lbs.

Financial.—Cost, $20,000. Ann. rev.: at time of report, from public, only, amount not given.

Management.—Prest., Miles Ayrant. Secy., H. Williard.

No other data given.

NYACK, *Rockland Co.* (Pop., 3,881: est., 6,500.) On west bank of Hudson river, on steep and rocky ground. Manufactures shoes and hats. Incorp. a village in '83.

History.—Built in '73 by Nyack Water-Works Co. Engr., Wm. Voorhis.

Water Supply.—Springs and Hackensack river, by gravity and pumping to reservoir.

Reservoirs.—Six; combined cap., 2,000,000 galls. The five smaller reservoirs receive the water from springs, four of them have a cap. of 60,000 galls. each. The larger reservoir receives the water pumped from river, and is two miles from and 275 ft. above it, and 300 ft. above village. It is in excavation, with lining of stone laid in cement, and has a cap. of 1,000,000 galls.

Filter.—River water is filtered by passing through two apartments filled with charcoal, and one with sponge.

Pumping Machinery.—Blake duplex pump, with 18-in. steam and 9-in. water cylinders, and 18-in. stroke. Connected with reservoir by two miles of 8-in. cast-iron pipe.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. *Taps*, 315. *Meters*, 1. *Hydrants*, Mathews, 27. *Valves*, McLean, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, about $180,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., including construction, $10,000. Ann rev.: consumers, $9,000; city, $1,500; number of hydrants not limited.

Management.—Prest., Wm. Voorhis. Secy., A. M. Voorhis. Supt., Wm. L. Voorhis.

OGDENSBURGH, *St. Lawrence Co.* (Pop., 10,341; est., 11.000.) On St. Lawrence at mouth of Oswegatchie river, 72 miles below Lake Ontario. Summer resort, and engaged in commerce and manufacturing. Founded in '49; incorp. a village in '17, a city in '68.

History.—Built in '68 by city. Engr., G. W. Pearsons, now of Kansas City, Mo.

Water Supply.—Oswegatchie river, direct pumping.

Pumping Machinery.—Holly pumps, driven by water power, with auxiliary steam engine. Flanders piston pump added.

Distribution.—*Mains*, c. i., w. i. and cement, 15½ miles. *Services*, galv. i. *Taps*, 1,300. *Meters*, none. *Hydrants*, kind not given, 88.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, $135,000. Bonded debt, $135,000. Int., 3½%. Ann. op. exp., $2,500. Ann. rev.: consumers, $10,000; city, $5,000.

Management.—Supt., A. H. Lord.

OLEAN, *Cattaraugus Co.* (Pop., 3,036; est., 9,000.) On Allegheny river. Has oil and manufacturing interests. Incorp. a village in '54,

History.—Built in '78 and rebuilt and extended in '83, under superintendence of S. D. Miller.

Water Supply.—Well, by pumping to reservoir. Well is 25 ft. in diam., 16 ft. deep, has 20 3-in. pipes driven 15 ft. in bottom, and is connected with Alleghany river, for emergency supply, by a 12-in. cast-iron pipe.

Pumping Machinery.—Dy. Cap., 2,500,000 galls; Worthington Duplex pump, with 14-in. steam and 10-in. water cylinders of 20-in. stroke. Water is forced to reservoir, 250 ft. above pump, through 2,000 ft. of 12-in. cast-iron pipe.

Reservoir.—Cap., 2,500,000 galls.; is in excavation and embankment, 230 to 250 ft. above village. Is 65 ft. sq. at bottom, and 20 ft. deep, with side slopes 1½ to 1, puddled with 18 in. of clay and lined with brick. An earth embankment 10 ft. high divides it in two compartments.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 640. *Meters*, 3. *Hydrants*, Ludlow, 82. *Valves*, Ludlow.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $75,000. Debt, $80,000. Int., 4½%. Ann. op. exp. $3,791. Ann. rev.: consumers, $5,250; city, $3,600.

Management.—Three Commrs. Clerk and Supt., J. Z. Lefevre.

ONEIDA, *Madison Co.* (Pop., 3,964; est., 6,000.) In Lenon township. Has manufactories.

History.—Built in '83 by Warner Water-Works Co., under 50 years' franchise. Engr., J. W. Warner.

Water Supply.—Large springs, by gravity from impounding reservoir.

Reservoir.—Cap., 22,350,000 galls.; formed by dam across stream, flooding 6½ acres, the depth at dam being 28 ft.; 190 ft. above, and 2¾ miles from village.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 73. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $142,000. No debt. No further data given.

Management.—Prest. and Supt., J. W. Warner.

ONEONTA, *Otsego Co.* (Pop., 3,002; est., 7,000.) On Oneonta creek, on hilly ground. Engaged in trade and manufacturing.

History.—Built in '82 by Oneonta Water-Works Co. Engr., W. B. Rider, So. Norwalk, Conn.

Water Supply.—Oneonta creek, by gravity from impounding reservoir.

Reservoirs.—An earth dam across stream, with stone heart-wall, 150 ft. long and 30 ft. high, floods 7 acres area, and stores 20,000,000 galls. of water 180 ft. above village. There is another storage reservoir of 500,000,000 galls. cap.

Filter.—Of sponge and charcoal, at outlet chamber of dam.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 425. *Meters*, 3. *Hydrants*, R. D. Wood & Co.'s, 47. *Valves*, kind, do.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $100,000. Capital stock, $55,000. Bonded debt, $25,000. Int., 5 and 6%. Hydrant rental, $30. No other data given.

Management.—Prest., Munro Westcott. V. Prest., Geo. I. Wilbur. Secy., Jas. Stewart. Treas., E. A. Scramling. Supt., T. A. Norton. Asst. Supt., S. Diefendorf.

OSWEGO, *Oswego Co.* (Pop., 21,116; est., 24,000.) On northern shore of Lake Ontario, at mouth of Oswego river, which has a water-shed of about 3,000 sq. m., embracing 7 of the larger interior lakes of the State. City is on both sides of river, from which ground rises about 200 ft. River is dammed for manufacturing purposes and slack-water navigation, affording good water-power. Has extensive flour and starch manufactories, and considerable commerce.

History.—Built in '68 by Oswego Water-Works Co. Engr., Wm. J. McAlpine, New Brighton.

Water Supply.—Oswego river, pumping to two reservoirs.

Pumping Machinery.—Kingsford pump, driven by water-power; dy. cap., 4,000,000 galls.

Reservoirs.—Combined cap., 15,000,000 galls.; one reservoir on each side of river, the east being 160, and the west, 190 ft. above lake. Both are in excavation and embankment, in two divisions, with sand and gravel filter in partition wall.

Distribution.—*Mains*, c. i., 38 miles. *Services*, w. i. *Taps*, 1,000. *Meters*, 12. *Hydrants*, kind not given, 185. *Valves*, Ludlow.

Consumption, 3,000,000 galls. *Pressure*: Ordinary, 20 to 70 lbs. Fire, 50 to 75 lbs.

Financial.—Cost, $500,000. Debt, $287,000. Int., 5 to 7%. Ann. op. exp., $16,500. Ann. rev.: consumers, $16,000. city, $15,000, for hydrants and 18 drinking fountains.

Management.—Prest., T. S. Mott. V. Prest., Chas. Rhodes. Supt. and Secy., H. H. Lyman.

OSWEGO FALLS, *Oswego Co.* (Pop., 1,831; est., 2,200.) On Oswego river, 12 miles from Oswego. Manufacturing village.

History.—Supplied in '85 from works at Fulton. Controlled by Moffett, Hodgkins & Clarke, Watertown.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, not given. *Taps*, 70. *Meters*, 1. *Hydrants*, kind not given, 20.

Consumption, unknown. *Pressure*: Ordinary, 55 lbs. Fire 12 lbs.

Management.—Treas. of Fulton Co., F. A. Emerick.
See Fulton for further details.

OWEGO, *Tiogo Co.* (Pop., 5,525; est., 6,000.) On Owego creek at its junction with Susquehanna river, in hilly region. Engaged in lumber trade and manufacturing.

History.—Built in '79 by Owego Water Co. under 10 year's franchise. Engr. and Contr., S. L. Wiley, Omaha, Neb.

Water Supply.—Barnes creek, by gravity from impounding to distributing reservoir. Creek is mountain stream with drainage area of about 3 sq. m. There is also an auxiliary supply by pumping from well. This is seldom used.

Dam and Reservoirs.—A dam on creek 60 ft. high, with inner slopes 2½ to 1, outer, 2 to 1, forming reservoir 2½ miles from, and 235 ft. above town. Distributing reservoir: is 150 by 70 ft., by 10 ft. deep, has paved slopes, is on hill near town, and connected with impounding reservoir by 12-in. cast-iron pipe.

Filter.—Of sand and gravel at dam.

Pumping Machinery.—Deane pump, dy. cap., 500,000 galls.

Distribution.—*Mains*, c. i., w. i., 10.5 miles. *Services*, w. i. *Taps*, 393. *Meters*, 17. *Hydrants*, Mathews, 56.

Consumption, 295,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $135,000. Capital stock, $80,000. Bonded debt, $80,000. Ann. rev., city, $2,800. Hydrant rental, $50. Other data withheld.

Management.—Prest., S. L. Wliey. V. Prest., W. A. Anderwood. Supt, Geo. Y. Robertson.

OXFORD, *Chenango Co.* (Pop., 1,209.) On Chenango river, Has some manufactories.

General Description.-Individuals bring spring water in 1¼-in. iron pipe, and sell same for domestic use. A dam on stream, and ¼ mile of pipe supply a fountain in park. A holly pump, driven by power from a mill ½ mile of 4-in. iron pipe, and 7 cheap hydrants are used for fire protection. Report made by D. B. Smith.

NORTH TARRYTOWN. *Westchester Co.* (Pop., 2,684.) In township of Mount Pleasant, one mile from Tarrytown. Manufactures shoes and edge-tools.

History.—Built in '88 by Pocantico Water-Works Co. under 30 year's franchise, to supply North Tarrytown, Dobb's Ferry and Hastings. Engr., A. L. Betts. Contr., J. M. Low, Kingston.

Water Supply.—Pocantico river, by direct pumping and pumping from impounding to distributing reservoir.

Pumping Machinery.—Combined dy. cap., 5,000,000 galls.; 2,000,000-gall. Deane, 1,000,000-gall. Gordon & Maxwell, and 1,000,000-gall. water-power pump, driven by 55 H. P. Risdon turbine.

Reservoirs.—Cap., 120,000,000 and 10,000,000 galls.

Distribution.—*Mains*, c. i., 21 miles. *Services*, rustless i. *Pressure*, 150 lbs.

Financial.—Capital stock, $500,000. Bonds, $287,000. Hydrant contracts: $50 each for 10 at North Tarrytown, 20 at Dobbs Ferry, 20 at Hastings; All adoitional, $40.

Management.—Prest,, E. A. Stoddard, Secy., Chas. H. Smith.
No further data could be given at time of report.

PEEKSKILL, *Westchester Co.* (Pop., 6,893: est., 7,000.) On east bank of Hudson river, on very irregular and steep hillsides. Has several iron foundries. Incorp. in '16.

History.—Built in '75 by city. Engr., Chas. E. Fowler.

Water Supply.—Van Cortland creek, pumping to reservoir. The creek has a drainage area of about 5 sq. m., the formation of which is mostly slate, with some gneiss overlying limestone.

Pumping Machinery.—Corliss engine and Vergennes pump. dy. cap., 660,000 galls. Originally pumps were driven by two American turbines, the creek being dammed to furnish power.

Reservoir.—Cap., 36,955,779 galls.; formed by building two dams across the outlets of an old basin having gently sloping sides, the basin being excavated 6 ft. below original surface, making a depth of water of 16 ft. and area of about 5 acres. The dams are of earth, from the excavation, and the inner slopes of the reservoir 1½ to 1. Arrangements are made for direct service during repairs to reservoir and for drawing out the water 2½ ft. below surface.

Distribution.—*Mains*, c. i., 9.8 miles. *Services*, galv. i., rubber coated i. *Taps*, 612. *Meters*, 58. *Hydrants*, Mathews, 86.

Consumption, 280,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 180 lbs.

Financial.—Cost., $150,000. Debt, $150,000. Int., 7 %. Ann. op. exp., $3,655. Ann. rev.: consumers, $7,059; city, $5,715.

Management.—Five Commrs. Prest., Jas. T. Sutton. Secy., I. Yocom. Treas., F. M. Dann. Supt., Orrin J. Loder.

NOTE:—Further details are given in *Eng. News*, vol. VIII., pp. 341-2.

PHŒNIX, *Oswego Co.* (Pop., 1,312; est., 2,500.) On Oswego river, 15 miles from Syracuse. Has good water-power, partly used for manufacturing.

History.—First supplied in '79. Following report describes works completed in in '88 by Phœnix Water Co. Des. Engrs., Bassett Bros., Buffalo. Const. Engr., J. I. Van Doren, Phœnix. Contrs. for masonry, William Patrick; for buildings, J. I. Van Doren; for pipe laying, W. A. Walters, all of Phœnix.

Water Supply.—Oswego river, wells and springs, pumping to stand-pipe.

Pumping Machinery.—Volker & Felthousen pump, dy. cap., 1,500,000 galls.; driven by water-power.

Stand Pipe.—Is 20 ft. in diam. by 80 ft. high, made by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i., galv. i. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Consumption, not yet known. *Pressure*: Ordinary, 75 lbs. Fire, 130 lbs.

Financial.—Cost, $55,000. Capital stock, $40,000. Bonded debt, $40,000. Int., 6 %. Hydrant rental, $45.

Management.—Prest., J. I. Van Doren. V. Prest., L. J. Currier. Supt., Secy. and Treas., Van R. Sweet.

Work in progress at time of report.

PLATTSBURGH, *Clinton Co.* (Pop., 5,245.) On Lake Champlain and Saranac river. Engaged in manufacturing and lake commerce.

History.—Built in '70 by village.

Water Supply.—Surface water, by gravity from impounding and distributing reservoirs; former is about 6, and the latter about 2 miles from village. A second line of pipe is being laid between the two in '88.

Distribution.—*Mains*, c. i., cement, 15 miles. *Services*, iron. *Meters*, none. *Hydrants*, 65.

Consumption, 500,000 galls. *Pressure*: Ordinary, 86 lbs. Fire, 86 lbs.

Financial.—Cost, (in '81.) $180,000. Ann. op. exp., $4,336. Ann. rev.; consumers, $16,360; city, none.

Management.—Three Commrs.: E. S. Winslow, C. E. M. Edwards and Wm. P Mooers. Supt., D. C. Boynton.

NOTE:—Figures under Distribution are for '81. Later figures cannot be obtained, as they are not known by the Commrs.

PENN YANN, *Yates Co.* (Pop., 3,475; est., 4,500.) In townships of Benton and Milo, at outlet of Lake Kenka, which furnishes water-power used in extensive manufactories. Settled in '14; incorp. a village in '33.

History.—Built for fire protection in '84. The pumps are owned by Russell, Andrews & Birkett, the pipe and hydrants by village.

Water Supply.—Outlet of Lake Kenka, by direct pumping. Lake is from ½ to 1 mile wide, and 22 miles long.

Pumping Machinery.—Two pumps, one driven by 20, and one by 40 H. P. water wheel; dy. cap., about 150,000 galls.

Distribution.—*Mains*, ½ mile. *Hydrants*, made by Commercial Iron Works Co., Penn Yann, 16. *Valves*, kind, do.

Pressure: 60 lbs.

Financial.—Cost, $1,500. No rev. and no exp., save for repairs.

Management.—Sup [illegible]. Saunders.

PORT BYRON, *Cayuga Co.* (Pop., 1,146; est., 1,500.) At outlet of Owasco Lake. Engaged in manufacturing. Settled in 1797; incorp. a village in '37.

History.—Built for fire protection in '72 by village.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Made by Rumsey & Co., Seneca Falls; dy. cap., about 150,000 ls.

Reservoir.—Cap., 200,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, c. i. Pipe furnished by Camden Iron Works, Camden, N. J., and laid by Wm. Jones, Port Byron. *Taps*, 50. *Meters*, none. *Hydrants*, kind not given, 26.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $12,000. No debt. Ann. op. exp., none. Ann. rev.: consumers $250.

Management.—Trustee, Jno. L. Davis.

PORT CHESTER, *Westchester Co.* (Pop., 3,254; est., 6,000.) Has iron and other manufactories.

History.—Built in '84 by Port Chester Water-Works Co. Rye is also supplied. Engr., Wm. B. Rider, South Norwalk, Conn.; remodeled by Jno. W. Rutherfoord, New York, and Wm. S. Beach. Contrs., all extensions made by Jno. O. Merritt, Port Chester.

Water Supply.—Reservoir of Greenwich (Conn.) Water Co., by gravity.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i., lead. *Taps*, 500. *Meters*, 14. *Hydrants*, Mathews, 60. *Valves*, Chapman, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 118 lbs. Fire, 118 lbs.

Hydrant rental, $25. Further data withheld.

Management.—Prest., J. W. Lowesburgh. Secy., J. W. Diehl. Supt., Jno. Dayton, Greenwich, Conn.

PORT JERVIS, *Orange Co.* (Pop., 8,678; est., 10,000.) On Delaware river, on irregular ground. Engaged in manufacturing.

History.—Built in '70 by Port Jervis Water-Works Co. Des. Engr., Jno. B. Jervis, deceased. Const. Engr., H. H. Farnum.

Water Supply.—Surface water, by gravity from storage reservoirs. Drainage area, about 380 sq. m.

Reservoirs.—Combined cap., 275,000,000 galls. The first reservoir is 125 ft. above village, and is formed by an earth dam flooding 17 acres, and impounding 75,000,000 galls. The second reservoir is 3 miles from, and 400 ft. above, first, covers 20 acres, and has cap. of 200,000,000 galls. Water is discharged from it by syphon over the dam, and flows to lower reservoir through channel of brook. A 12-in. main leads to village from lower reservoir.

Distribution.—*Mains*, c. i., 5.3 miles. *Services*, galv. i., lead. *Taps*, 600. *Meters*, none. *Hydrants*, Mathews, 140.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 58 lbs. Fire, 75 lbs.

Financial.—Capital stock, $15,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $8,000; city, $2,058. Hydrant rental, not given.

Management.—Prest., Peter E. Farnum. Secy., W. H. Crane. Supt., E. H. Ellis.

PORT RICHMOND, *Richmond Co.* See New Brighton and Port Richmond.

PATCHOGUE, *Suffolk Co.* (Pop., est., 5,000.) Engaged in manufacturing, fishing and oyster business.

History.—Built in '87 by Suffolk County Water Co., under a 50 years' franchise. Engr., Jno. Lockwood, New York. Contr., Jno. C. Lockwood, New York.

Water Supply.—Six-in. pipe wells, 40 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Holly pump, dy. cap., 1,500,000 galls.

Stand-pipe.—Is 20 ft. in diam. by 100 ft. high; made by Southwark Foundry & Machine Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. Pipe furnished by Warren Foundry and Machine Co., Phillipsburg, N. J., and specials by Builders' Iron Foundry, Providence, R. I. *Taps* and *Meters*, not given. *Hydrants*, Holly, number not given. *Valves*, Holly.

Financial.—Cost, $100,000. Capital stock, $40,000. Bonded debt, $60,000. Int., 6%. Hydrant rental, $40. No further data given.

Management.—Prest., Jno. Lockwood, New York. Secy., A. K. Gregory. Supt., Wm. E. Ritchie.

POTSDAM, *St. Lawrence Co.* (Pop., 2,762; est., 3,800.) On Racket river. Engaged in lumber and other manufacturing, and quarrying sandstone.

History.—Built in '71 by village. Engr., Galen W. Pearsons, Kansas City, Mo.

Water Supply.—Racket river, by direct pumping. River has drainage area of 30 sq. m.

Pumping Machinery.—Two Holly pumps, driven by water-power; dy. cap., 1,500,000 galls.

Distribution.—*Mains*, w. i. and cement, 4½ miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 37. *Valves*, Eddy.

Consumption, 250,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Debt, $47,000. Int., 7%. Ann. op. exp., $675. Ann. rev.: consumers, $3,500; city, none.

Management.—Supt., D. A. B. Bailey.

POUGHKEEPSIE, *Dutchess Co.* (Pop., 20,207; est., 22,000.) On Hudson river, on ground rising rapidly from river to plateau 150 to 200 ft. high, and at College hill to 500 ft. Settled in 1690; incorp. a city in '54.

History.—Built in '70 by city, when population was 20,080. Engr., J. B. S. Rand. Consulting Engr., James P. Kirkwood. Both deceased.

Water Supply.—Hudson river, pumping to settling basin, from which water passes through filters to reservoir, and is pumped to distributing reservoir.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington compound condensing pumps, one for filter bed, and one for main pumping.

Inlet Pipe.—To pump-well; first a box conduit, which was changed in '77 to 107 ft. of 24-in. cast-iron pipe in box, filled round with concrete. The whole length weighed 35 tons, and was sunk together.

Settling Basin and Filters.—Former is 20 ft. above lower pump-well, 25 by 60 ft., by 12 ft. deep, and in three compartments. There are two filter beds, each 73½ by 200 ft., by 12 ft. deep, with 6 ft. of filtering material arranged as follows: 24-in. sand, 6 of ¼-in. gravel, 6 of 2-in. broken stone, and 24 of 4 to 8 in. broken stone, resting on concrete floor, on which are open stone culverts conveying the filtered water to an intermediate basin, 6 by 85 ft. by 16 ft. deep. From this it passes to a reservoir, 28 by 88 ft., by 17 ft. deep, and from here by 408 ft. of 18-in. pipe, to the second pump-well.

The filter beds cost $54,000. The cost of removing ice, cleaning beds and washing sand in '87 was $795.42. As 644,858,352 galls. were filtered, the cost per million galls. was $1.23. In Aug., Sept., Oct., and part of Nov. an unprecedented development of low plant life appeared on the surface of the sand, first in minute patches as soon as the beds were cleaned, and in a few days covering the whole surface like a blanket, and allowing no water to pass through. This plant life was a filamentous algae, known as genus Oscillatoria. The beds were washed twice during these months, ordinarily but once.

Reservoir.—Cap., 12,000,000 galls.; on College hill, 264 ft. above, and 7,700 ft. from, pump-well, with which it is connected by 18-in. cast-iron pipe; is in excavation and embankment, 210 by 540 ft., by 11.5 ft. deep, with puddle wall in center of banks, and puddled bottom covered with 3-in. of coarse gravel.

Distribution.—*Mains*, c. i., 18.4 miles. *Services*, lead. *Taps*, 1,790. *Meters*, 530, mostly Crown and Worthington. *Hydrants*, kind not given, 315.

Consumption, 1,766,735 galls. *Pressure*: 40 to 120 lbs.

Financial.—Cost, $583,655. Debt, $550,000. Int., 7%. Ann. op. exp., $18,000. Ann. rev.: consumers, $25,000; city, none.

Management.—Six Commrs. Supt., Chas. E. Fowler.

PRATTSVILLE, *Greene Co.* (Pop., est., 600.) On Scholarie creek, in Catskill mountains.

History.—Built in '85 by Prattsville Water Co., under 10 years' franchise. Engr. Francis Leonard, Norwalk, Conn.

Water Supply.—Not given.

Distribution.—*Mains*, furnished by Norwalk Water Pipe & Construction Co., Norwalk, Conn. *Hydrants*, Ludlow. *Valves*, Ludlow.

Financial.—Hydrant rental, $25.

Management.—Prest., Francis Leonard, Norwalk, Conn. Supt. and Secy., Martin Chamberlain.

No further data given in time for insertion here.

PULASKI, *Oswego Co.* (Pop., 1,501; est., 1,800.) On Salmon river, 4 miles from Lake Ontario. Engaged in manufacturing.

History.—Built in '87 by village. Des. Engr., E. D. Smalley, Canastota. Const. Engr. and Contr., G. W. White, Pulaski.

Water Supply.—Spring brook, direct pumping from impounding reservoir.

Reservoir.—Covers about 3 acres.

Pumping Machinery.—Holly pump, dy. cap., not given.

Distribution.—*Mains*, c. i., 3 miles. *Hydrants*, 23.

Pressure: Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—Cost, $25,000. Bonded debt, $25,000. Int., 4%. No hydrant rental.

Management.—Prest. and Supt., Dr. F. S. Low. Treas., W. F. Austin. Secy., A. W. Dunn.

Works were being extended at time of report, so full data could not be given.

RANDOLPH, *Cattaraugus Co.* (Pop., 1,111; est., 1,500.) Engaged in manufacturing and lumber trade.

History.—Built in '85 by village. Engr. E. A. Curtis, Fredonia. Contrs., Chambers & Casey, Rochester.

Water Supply.—Spring, by gravity.

Reservoir.—Cap., 500,000 galls.; Contr., S. L. King, Randolph.

Distribution.—*Mains*, c. i., 4.5 miles. *Services*, w. i., lead. Pipe and specials furnished by Ormrod, Fisher & Co., Emaus, Pa. *Taps*, 136. *Meters*, 1. *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 97 lbs. Fire, 97 lbs.

Financial.—Cost, $20,069. Debt., $20,000. Int., 4%. Ann. op. exp., slight. Ann. rev.: consumers, $1,035; city, none.

Management.—Secy. and Supt., G. E. Seager.

RICHFIELD SPRINGS, *Otsego Co.* (Pop., 1,307; est., 3,000 permanent, and 5,000 in summer.) In hilly country, near Schuyler lake, and has sulphur springs making it a summer resort.

History.—Built in '79 by Richfield Springs Water-Works Co. Engr., P. H. Baerman, Troy. Contrs., Sherman & Flagler, Utica; Sullivan & Wilkerson, Syracuse.

Water Supply.—Allen's lake, pumping to reservoir.

Pumping Machinery.—Worthington, dy. cap., 1,000,000 galls.

Reservoir.—Cap., 9,000,000 galls.

Distribution.—*Mains*, c. i., 5. miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, 500,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $50,000. Bonded debt, $43,500. Int., 5 and 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $3,700; city, none.

Management.—Village Trustees. Report made by H. C. Watson.

ROCHESTER, *Monroe Co.* (Pop., 89,366; est., 130,000.) On Genesee river, 7.3 miles from, and 263 ft. above, Lake Ontario. City is on both sides of river, which, in passing through the city, has three falls of 96, 26 and 83 ft. respectively. City is built on limestone rock, and both river and well water is very hard. Engaged in commerce, nursery business and manufacturing, having a large number of flouring mills. Settled in '12; incorp a city in '34.

History.—Built in '72-6 by city. Engr., J. Nelson Tubbs. Contr., Jas. McDonald, Willsborough Falls.

Water Supply.—Hemlock and Canadice lakes and Genesee river, by gravity to storage and distributing reservoirs; from Genesee river, by direct pumping, for an independent supply in business part of town for fire protection and hydraulic motors. Water is taken from Hemlock lake, 28 miles south of the city, and 388 ft. above Erie canal in city. Lake is 6.7 miles long, 0.6 miles wide, from 45 to 90 ft. deep, has an area of 2.15 miles, and a drainage area of 42.39 miles. It lies in a valley surrounded by steep hills, the soil of which is underlaid by shale. The water of the lake is very soft.

Canadice lake is in a valley east of and joining the Hemlock valley, is 3.1 miles long ½ of a mile wide, and has a drainage area of 1 sq. m.

Hemlock Lake Conduit.-From Hemlock lake to Rush storage reservoir, is of cast and wrought-iron pipe, the inlet being at a timber crib 1,000 ft. from shore and in 36 ft. of water. The crib is 12 ft. sq. by 9 ft. high, made of 6 by 12-in. oak and pine, bolted together, with a bottom of 3-in. oak planks and the top covered with a wire screen. The crib is loaded with stone. The first section of the conduit is of riveted wrought iron pipe. the first 700 ft. from inlet crib being laid in a trench by means of coffer dams. Next comes three sections 97, 100 and 74½ ft. long, connected with ball and socket joints, the outer end of the last section being funnel shaped. These sections were laid on timber platforms. For this distance, and continuing from the shore for 49,776 ft.,the conduit is 36-in. wrought pipe and has a fall of 47 ft.; then comes 1,918.65 ft. of wrought-iron, 30,549.75 f . of cast-iron, 13,809.38 ft. of wrought-iron, and 5,222.27 ft. of cast-iron pipe, all 24-in. Here the gate-house of the Rush reservoir is reached, the flow line of the reservoir being 143 below Hemlock lake and 242 ft. above city datum. The conduit follows the surface of the ground, which in some places is 340 ft. below hydraulic grade line. In '79 a break occurred in the 24-in. cast-iron pipe and several joints were reported as being started.

Rush Storage Reservoir.—Cap., 65,596,000 galls.: is 10 miles from city hall, in excavation and embankment, with area of 13.871 acres and depth of 19 ft. The banks are 23¼ ft. high, above bottom of reservoir, 16 ft. wide on top, and have a center puddle wall beginning 10 feet below bottom of reservoir; for 8 ft. above bottom o reservoir, wall is 10 ft. wide, then for 12 ft. is 6 ft. wide. Outer slope of reservoir is 2½ to 1, and inner 2 to 1, with level break of 5 ft., 7 ft. below water line, or 11¼ ft from top of bank. Inner slope is covered for 12 in. with gravel, then for 2 ft. with riprap. Bottom has 18 in. of puddle, covered with 8 in. of gravel. Effluent pipe is laid in a masonry gate-house at center of reservoir.*

Conduit to Distributing Reservoir at Mount Hope is 46,064 ft. of 24-in, cast-iron pipe, and has fall of 127 ft.

Mount Hope Distributing Reservoir.—Cap., 24,278,000 galls.; is ¾ miles from city hall; its construction is similar to that of the Rush reservoir; its area is 5.517 acres, depth, 15 ft., and its flow line is 124.4 ft. above Erie Canal in city. Banks are 20 ft. from bottom of reservoir, and 16 ft. wide on top. Influent pipe enters masonry gate-house in center of reservoir, and discharges upward under head of 127 ft., forming a fountain jet. The influent pipe can be connected with effluent, giving an increased pressure in city in case of fire. This is done at every fire alarm.

Genesee River is crossed by pipes on a bridge. Two compartments of cast-iron, 3 by 3¼ ft., were made. Through each of these two 12-in wrought-iron pipes of ¼-in. iron were carried, each branching at each end from an 18-in. cast-iron pipe with slip joints. Pipes over bridge are packed in fine charcoal to prevent freezing.

Pumping Machinery. –Cap.,7,000,000 galls.; Holly pumps, and steel boilers made by Woodbury Engine Co. Pumps are used to furnish the business part of town with an independent supply for fire protection and hydraulic motors.

Distribution.—*Mains*, c. i., w. i., 216 miles. *Services*, lead. Pipe and specials furnished by B. S. Clark, New York. *Taps*, 17,000. *Meters*, 1,500. *Hydrants*, Mathews, 1,713. *Valves*, Ludlow. *Pressure gauge*, Edson.

Consumption, 7,200,000 galls. *Pressure*: Ordinary, 35 to 85 lbs. Fire, 112 lbs.

Financial.—Cost, $3,866,123. Debt, $3,182,000. Int., 7 %, Ann. op. exp., $30,000, Ann. rev.: consumers, $196,456: city, $100,000.

ROCKAWAY BEACH, *Queens Co.* See Far Rockaway.

ROME, *Oneida Co.* (Pop., 12,194; est., 14,000.) On Mohawk river at junction of Black river and Erie canal, on level ground. Manufactures knit and iron goods, saddles and locomotives.

History.—Built in '73 by city. Engr., Peter Hogan, Albany. Contr. for masonry, J. J, Parry, Rome. City erected buildings.

Water Supply.—Mohawk river at point two miles above city, pumping to reservoir and direct pumping in case of fire.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; pumps made by Watertown Steam Engine Co., and driven by turbine wheels put in in '88, made by S. Morgan Smith York, Pa. The present pumps were put in in '85, and were designed by Chas. W. Knight, Rome.

Reservoir.—Cap., 9,000,000 galls.; is 330 ft. in diam., 25 ft. deep, and 60 ft above pumps. Contr., David French, Syracuse.

Distribution.—*Mains*, c. i., w. i, and cement, 19 miles; w. i. and cement pipe is fast being replaced with c. i. *Services*, lead. *Taps*, 988. *Meters*, none. *Hydrants*, 131. Pipes, specials, valves and hydrants furnished, and pipe laid by American Water & Gas Pipe Co., Jersey City, N. J.

Consumption, 1,760,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Original cost, $160,000. Bonded debt, $160,000. Int., 7 %. Ann. op. exp., $2,500. Ann. rev., consumers, $14,265; c ty, none.

Management.—Commrs. Supt., Chas. T. Hayden.

ROUND LAKE, *Saratoga Co.* (Pop., est., 300.) Near Saratoga; a summer resort.

History.—Built in '87 by Round Lake Assn. Engrs., Landreth & Fitzgerald, Schenectady. Contr., Benj. Van Vranken, Schenectady.

Water Supply.—Springs, collected in reservoir, pumping to tanks, for domestic use; for fire protection water is pumped direct from lake.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, c. i. All houses supplied. *Hydrants*, 9.

Consumption, 700,000 galls. in summer. *Pressure*: 50 lbs.

Financial.—Not given.

Management.—Supt., Jno. D. Rogers.

RYE, *Westchester Co.* (Pop., not given.) About 1½ miles from village of Port Chester.

History.—Supplied in '84 by Port Chester Water-Works Co., which see.

SAINT JOHNSVILLE, *Montgomery Co.* (Pop., 1,072; est., 1,200.) On plateau with Mohawk flats and river on south, and elevated land on the north. Settled in '18; incorp. a village in '37.

History.—Built for domestic supply in '79 by village.

Water Supply.—Springs in edge of village, by gravity.

Reservoirs.—Two, each 50 ft. sq. and 8 ft. deep.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 125.

Consumption, not given. *Pressure*: 80 ft. head.

Financial.—Cost, $5,500. Debt, $1,500. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $500; city, none.

Management.—Village Trustees. Report made by G. Hough.

SALAMANCA, *Cattaraugus Co.* (Pop., 2,531; est., 4,500.) On Allegheny river, on hilly ground. Has repair shops for three railroads; manufactures embroidery, leather and lumber.

History.—Built in '81 by Salamanca Water Works Co., under a 5 years franchise, Des. Engr., J. O. McClure, Warsaw. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Springs and surface water, generally by gravity, but in dry weather by pumping to reservoir.

Reservoirs.—Cap., 1,500,000 and 500,000 galls., respectively.

Pumping Machinery.—Gordon & Maxwell duplex pump, dy. cap., 350,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, mostly galv. i. *Taps*, 180. *Hydrants*, Mathews, 37.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $30,000. Debt, $20,000. Int., 6 %. Ann. op. exp., $300. Ann. rev.: consumers, not given; city, $1,250. Hydrant rental, $33.79.

Management.—Prest., Hudson Ansley. Secy., H. O. Wait. Supt., A. H. Krieger.

SANDY HILL, *Washington Co.* (Pop., 2,487; est., 3,000.) In Kingsbury township, on Hudson river. Engaged in manufacturing.

History.—Built in '88 by Spring Brook Water Co. Engr., Wm. B. Rider, South Norwalk, Conn. Contrs., Sherman & McDonough, West Troy.

Water Supply.—Brook, fed by springs, pumping to stand-pipe. Dy. cap. of brook, 750,000 galls.

Pumping Machinery.—Dy. cap., 150,000 galls. Two Worthington compound duplex pumps.

Stand-Pipe.—Steel, 18 ft. in diam., 120 ft. high, and gives a head of 161 ft.; made by Porter Mfg. Co., Syracuse.

Distribution.—*Mains*, c. i., 6¾ miles. *Services*, c. i., lead. *Taps*, 60, adding more. *Meters*, none. *Hydrants*, Mathews, 40. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 50 lbs. Fire, 60 to 70 lbs.

Financial.—Cost, about $60,000. Stock and bonds, $70,000. Ann. rev.: city, $2,500. Hydrant rental, $62.50. Other data not determined.

Management.—Prest. and Supt. Jno. Cunningham. Secy., Jas. E. Flood. Treas., R. W. Sherman, Utica.

SARATOGA SPRINGS, *Saratogo Co.* (Pop., 8,421; est., resident 14,000 summer, 30,000.) A summer resort, noted for its medicinal springs, and many attractions. Settled in 1773.

History.—Built in '71 by village. Des. Engr., H. F. Gaskill. Const. Engrs., Holly Mfg. Co., Lockport.

Water Supply.—Loughberry lake, by direct pumping. Lake has area of 96 acres, depth of about 20 ft., is 336 ft above sea level, and fed by springs. Town is from 220 to 400 ft. above sea level.

Pumping Machinery.—Holly-Gaskill pumping engine, and Chute Bros., boilers; dy. cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 26 miles, *Services*, galv. i. *Taps*, 1,700. *Meters*, 10. *Hydrants*, Ludlow, Holly, Mathews, 203. *Pressure gauge*, Edson.

Consumption, 3,000,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 130 lbs.

Financial.—Cost, $300,000. Debt, $267,000. Int., 4 to 7 %. Ann. op. exp., $12,500. Ann. rev.: consumers, $38,000: city, none.

Management.—Five Commrs. Prest., F. G. Ruhan. Clerk, Saml. F. Carey. No Supt.

NOTE:—For extended description of pumping engines and tests of same, see *Eng. News*, vol. X. p. 332, vol. XI., pp., 195-9.

SAUGERTIES, *Ulster Co* (Pop., 3,923; est., 5,000. On Hudson river at mouth of Esopus creek, 12 miles above Kingston. Has several manufactories.

History.—Built in '87 by Saugerties Water Co., under 30 years' franchise. Engrs., Arthur L. Betts and J. M. Low. Contr., J. M. Low, Kingston.

Water Supply.—Plotull creek, by gravity.

Distribution.—*Mains*, c. i., 12 miles. *Services*, rustless i. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 52. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Capital stock, $100,000. Bonded debt, $100,000. Int., not given. Ann. rev.: city, $2,000. Further data not determined at time of report.

Management.—Prest., Matthew Trumpbower. Treas., Frank D. Bruyn. Secy., Edwin B. Walker.

SCHENECTADY, *Schenectady Co.* (Pop., 13,655; est., 20,000.) On Mohawk river. Engaged in manufacturing. Settled in 1684, created a borough 1765, incorp. a city in 1798.

History.—Built in '71; purchased by city in '85, from Schenectady Water Co.

Water Supply.—Mohawk river, by direct pumping.

Intake Crib and Pipe.—Crib is 13 ft. sq., of 12 by 12 timber bolted together to form 9 compartments, the outer ones being filled with stone, and the inner ones being 4 ft. square, with two water-ways also 4 ft. square. At the mouth of each of the latter there are ¾-in. iron rods, 1 in. apart, then two copper wire screens, ⅛-in. mesh; besides these water must past through two similar screens before entering supply pipe. The screens can be removed for cleaning.

The top of the crib, and sides above low water, are covered with 3 in. oak plank. Piles are driven outside the crib, bolted to it and filled between with stone. *Supply-pipe* is 20 in. in diam., enters crib 5 ft. from bottom, and has 13 ball and socket joints to allow pipe to conform to surface of river bottom. The new crib and supply pipe were put in in '87. Engr., P. H. Baerman, Troy. Previously, water had passed through a filter gallery near river.

Pumping Machinery.—A 2,000,000-gall. Deane and 3,000,000-gall. Gaskill pump; the latter, and two boilers, were put in by the Holly Mfg. Co. in '87.

Distribution.—*Mains*, w. i. and cement, 16.3 miles. *Services*, w. i. *Taps*, 1,200. *Meters*, 40. *Hydrants*, kind not given, 154. *Pressure gauge*, Edson.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 85. Fire, 100 lbs.

Financial.—Cost, $125,000. Debt, $107,000. Int., 3 and 4%. Ann. op. exp., $7,660. Ann. rev.: consumers, $22,294; city, none.

Management.—Three Commrs. Prest., Peter Van Dyck. Clerk, E. E. Kriegsman. Supt., M. O. Caldwell. Chief Pumping Engr., J. C. Schermerhorn.

SHEEPSHEAD BAY, *Kings Co.* See Gravesend.

SHERBURNE, *Chenango Co.* (Pop., 944; est., 1,000.) On Mad brook, a tributary of Chenango river.

History.—Built in '83 by village. Also supplies the small village called Sherburne quarter. Des. Engr., W. S. Franklin, Johnstown. Const. Engr., A. J. Read.

Water Supply.-Surface water, by gravity from impounding reservoir on stream having drainage area of about 2,000 acres.

Reservoir and Dam.—Cap., 10,000,000 galls; is 1¾ miles from, and 240 ft. above village. Dam is of earth, with puddle core, 40 ft. high, 10 ft. wide on top, with outer slope 2 to 1, inner, 2½ to 1 riprapped to depth of 20 in. Has masonry waste-weir, 40 ft. long, and 20-in. waste-pipe under embankment. A 10-in. cast-iron pipe conducts water to village.

Stand-Pipe.—Enclosed in masonry tower, is 12 in. in diam., and has inlet valves.

Distribution.—*Mains*, c. i., 4 miles. *Services*, black i. *Taps*, 130. *Meters*, none. *Hydrants*, Bailey, 21. *Valves*, Eddy.

Consumption, 30,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $31,000. Debt, $31,000. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $1,800; village, none.

Management.—Commrs. Treas., Jesse H. Shephard. Supt., W. E. Davis.

SHERBURNE QUARTER, *Chenango Co.* (Pop., est., 500.) In town and near village of Sherburne, with P. O. there.

History.—Supplied from Sherburne in '86. Has 4 hydrants and pays about $500 a year for its supply. All data included under Sherburne.

SENECA FALLS, *Seneca Co.* (Pop., 5,880; est., 8,000.) On Sececa river, having good water-power used in manufacturing knit-goods, hand and steam pumps, and fire engines.

History.—Built in '87 by private company. Engr., G. Norman Weaver, Newport, R. I. Contrs., New England Construction Co., Newport, R. I. Sub-Contr. for masonry and buildings, G. W. Bartowe, Seneca Falls.

Water Supply.—Cayuga lake, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; compound vertical piston pump, made by A. Russell & Son, Newburyport, Mass.

Stand-Pipe.—Is 30 ft. in diam. by 80 ft. high; made by R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, w. i. and cement, 12 miles. *Services*, w. i. and cement. *Taps*, 400. *Meters*, not given. *Hydrants*, Chapman, number not given. *Valves*, Chapman.

Consumption, 150,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—No data given.

Management.—Treas. and Supt., A. C. Martin.

SING SING, *Westchester Co.* (Pop., 6,578; est., 7,000.) In Ossining township, on Hudson river. Has various manufactories.

History.—Being built in '88 by village. Engr., Chas. W. Knight, Rome. Contr., for pumping station, Genung, Rider & Co., Sing Sing.

Water Supply.—Surface water, pumping from impounding to distributing and high service reservoirs.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; to be compound condensing pumping engine.

Reservoirs.—Impounding reservoir on brook at elevation of 188 ft., Croton datum, and Indian brook distributing reservoir, elevation 326.5 ft.; Contr., Ward & Leary, Jersey City, N. J. High service reservoir elevation, over 400 ft.; Contr., Genung, Rider & Co, Sing Sing.

Distribution.—*Mains*, c. i., 11.5 miles. Furnished by Gloucester Iron Works, Philadelphia, and laid by Scribner & Fogg, New York. *Hydrants* and *Valves*, R. D. Wood & Co.'s.

Financial.—Cost, $150,000. Bonds, $150,000.

Management.—Commrs. Secy., S. M. Sherwood. Further data can be given when work is finished.

SPRINGVILLE, *Erie Co.*, (Pop., 1,227; est., 2,000.) On Spring creek. Manufacturing town in dairying district.'

History.—Built in '88 by Springville Water-Works Co., from plans and under superintendence of C. J. Shuttleworth.

Water Supply.—Springs, by direct pumping from collecting reservoir.

Reservoir.—Is 50 by 100 ft., by 10 ft. deep.

Pumping Machinery.—Dy. cap., 750,000 galls.: Holly pumps, driven by Leffe urbine.

Distribution.—*Mains*, wooden, 2 miles. *Services*, lead. *Meters*, none. *Hydrants*, 18.

Pressure: Ordinary, 35 to 40 lbs. Fire, 80 lbs.

Financial.—Capital stock, $100,000.

Management.—Prest., Mrs. E. Corbet. Secy., L. J. Shuttleworth. Treas., C. R. Shuttleworth.

Not finished at time of report.

STAMFORD, *Delaware Co.* (Pop., 764; est., 1,300.) On Delaware river, in mountainous district 1,800 ft. above sea-level. Settled in 1790; incorp. a village in '70.

History.—Built in '83 by Stamford Water-Works Co., under 99 years franchise. Engr., W. B. Rider, South Norwalk, Conn.

Water Supply.—Head water of Delaware river, one mile from its source, by gravity from impounding reservoir on small stream with drainage area of 3 sq. m.

Dam.—Forming reservoir, masonry laid in cement, 12 ft. high and 75 ft. long, with flow-line about 150 ft. above village.

Filter.—Wire screen, sponge and charcoal.

Distribution.—*Mains*, c. i., 3 miles. *Services*, lead. *Taps*, 85. *Meters*, none. *Hydrants*, Mathews, 16. *Valves*, Ludlow.

Consumption, not given. *Pressure*, Ordinary, 60 lbs. Fire, 55 lbs.

Financial.—Cost, $20,000. Debt, $4,300. Int., 6 %. Ann. op. exp., $125. Ann. rev.: consumers, $1,120; city, $230. Hydrant rental, $15.

Management.—Prest., V. Z. Wyckoff. Secy., W. Gillespie. Supt., Johnson Hamilton.

SUSPENSION BRIDGE, *Niagara Co.* (Pop., 2,476; est., 4,000.) On Niagara river, two miles from Niagara Falls village.

History.—Built in '75 by village. Also supplies village of Niagara Falls. Des. Engrs., Holly Mfg. Co., Lockport. Constr. Engr., C. F. Shelley, Lockport. Contr. for masonry, Jacob Wagner

Water Supply.—Niagara river, by direct pumping.

Pumping Machinery.—Combined dy. cap., 7,000,000 galls.; Holly-Gaskill pumps.

Distribution.—*Mains*, iron, miles not given. *Services*, iron. Pipe and specials furnished by Drullard & Hayes, Buffalo. *Taps*, not given. *Meters*, none. *Hydrants*, Holly, 55. *Valves*, Holly.

Consumption, 4,000,000 galls., total; 3,500,000 galls. by Suspension Bridge. *Pressure*: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $125,000. Bonded debt, $125,000. Int., 5, 6 and 7 %. Ann. op., exp., $2,500. Ann. rev.: consumers, $6,000; Niagara Falls, $4,000, including 40 % of water rents.

Management.—Commrs. Prest., W. P. Horne. Village Clerk, C. F. Liscom. Supt., Patrick Seymour.

SYRACUSE, *Onondaga Co.* (Pop., 51,792; est., 83,000.) On Onondaga lake, on gently undulating ground. Has large business and manufacturing industries, a large part of the salt industry of the continent centering here. Settled in 1796; incorp. a village in '25; a city in '47.

History.—First supplied in '29 by Oliver Tease, Aaron Borst and Ira Seymour, from springs, by gravity. In '49 the Syracuse Water Co. was organized and it owns the present works.

Water Supply.—Springs and surface water, by gravity, and by pumping to reservoir. Raynor and Taif springs supply the first reservoir constructed, which is 107 ft. above the Erie canal in the city, and from here their water goes to the main reservoir. In '71 water was pumped to reservoir from Onondaga creek. Later, water from Furnace brook was stored in a 176,000,000-galls. reservoir on Onondaga hill, 450 ft. above canal, and distributed from a 6,500,000-galls. reservoir 161 ft. above canal. This reservoir is not mentioned in the report for '88.

Pumping Machinery.—Combined dy. cap., 16,000,000 galls.; one 10,000,000-Worthington and two 3,000000-gall. Deane pumps, lifting water from Onondaga creek.

Reservoir.—Cap., 80.000.000 galls.

Distribution.—*Mains*, c. i., w. i. and cement, 46 miles. *Services*, lead. *Taps*, 2,509. *Meters*, 400. *Hydrants*, kind not given, 403.

Consumption, 6,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $727,000. Capital stock, $440,000. Bonded debt, $200,600. Int., 6 and 7 %. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $26,000 for all purposes.

Management.—Prest. and Supt., D. H. Bruce. V. Prest., A. H. Davis. Secy. and Treas., J. S. Butler.

NOTE:—There has been much agitation concerning a new supply. Several propositions have been made by companies and individuals, and the city has thought of building works. The Syracuse Water Co. claims sole right to furnish water to the city, and objections have been urged against the various sources of supply. The city is now testing a few gang wells with the idea of a possible future supply from a gang well system.

TARRYTOWN, *Westchester Co.* (Pop., 3,025; est., 6.500.) On Hudson river on ground rising abruptly 300 ft. Has manufactories.

History.—A fire protection system was built in '77, and domestic supply introduced in '81, both by village. Engr. of first, Chas. E. Fowler.

Water Supply.—Brook, for fire protection, and artesian well for domestic use, pumping to reservoir.

Pumping Machinery.—Woodward pump, dy. cap., not given.

Reservoir.—Cap., 200,000 galls.; in. rock excavation, 50 by 40½ ft., by 13 ft. deep, covered with 4 brick arches of 9 ft. span. 2 ft. rise, and springing from rubble stone masonry piers. Arches are covered with 1 ft. of earth.

Distribution.—*Mains*, c. i., 3 miles. *Hydrants*, 24.

Pressure: 128 lbs.

Financial.—Cost, (in '82) $16,500. Ann. op. exp., $1,000.

Management.—Address S. Bird or Warren C. Brown.

NOTE:—No official returns have been given since '82.

THOUSAND ISLAND PARK, *Jefferson Co.* (Pop., not given.) On Well's Island in St. Lawrence river. Summer resort.

Water is pumped from St. Lawrence river to reservoir. No further data can be obtained.

THE KINGS COUNTY FARM AND INSANE ASYLUM, *St. Johnand, Suffolk Co.* (Pop., 300.)

History.—Built in '88 by Kings County. Chf. Engr., J. F. Casey, New York. Resident Engr., A. T. Byrne. Contr., Ed. Freel, Brooklyn.

Water Supply.—Two wells, 8 ft. in diam., and surface water from drainage area of 1,000 acres, by direct pumping and pumping to reservoir.

Reservoirs.—Storage area, 5 acres, depth, 7 ft. Distributing: area, 1 acre, depth, 18 ft.; is in form of ellipse.

Pumping Machinery.—Worthington duplex, dy. cap., 1,400,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, c. i. *Taps*, 30, at time of report. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 40. *Valves*, kind, do.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $72,400. No further data given.

Management.—Resident Engr., A. T. Byrne.

TICONDEROGA, *Essex Co.* (Pop., est., 2,000.) On outlet of Lake George. Manufactures iron, lead, lumber, cotton and woolen goods.

History.—Built in '75 by Ticonderoga Water-Works Co. Engr., D. M. Arnold.

Water Supply.—Lake George, by grav y.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 150. *Meters*, none. *Hydrants*, furnished by N. A. Buck & Co., Philadelphia, 7 public and 2 private. *Valves*, Ludlow.

Consumption, 15,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost $20,000. Capital stock, $20,000. No debt. Ann. op. exp., $1,284. Ann. rev.: consumers, $2,884; city, $75. Hydrant rental, paid by individual subscriptions.

Management.—Prest., J. B. Ramsey. Treas., C. E. Bush. Secy. and Supt., C. E. Bennett.

TONAWANDA, *Erie Co.* (Pop., 3,864; est., 5,000.) On Niagara river, at outlet of Tonawanda creek. Manufactures lumber, and is one of the largest lumber centers in the United States.

History.—Built in '87 by Tonawanda City Water-Works Co. Des. Engr., Geo. P. Smith. Const. Engr., B. F. Betts, both of Tonawanda. Contrs. for masonry and buildings, Wm. C. Ling. Pipe laid by Co.

Water Supply.—Niagara river, by direct pumping.

Pumping Machinery.—Holly-Gaskill pump, dy. cap., 4,000,000.

Distribution.—*Mains*, 15 miles; Wycoff wood, furnished by Michigan Pipe Co., Bay City, Mich. *Services*, not given. *Taps*, 420. *Meters*, none. *Hydrants*, Gaskill, 180. *Valves*, Galvin.

Consumption, unknown. *Pressure*, Ordinary, 40 lbs. Fire, 80 to 150.

Financial.—Cost, $150,000. Capital stock. $30,000. Bonded debt, $120,000. Int., 6% Ann. op. exp., $4,000. Ann. rev.: consumers, $5,500; city, $8,080, being contract price for 14¼ miles of pipe and 180 hydrants, or $44.88 each.

Management.—Prest., B. L. Rand. Secy. and Treas.,Geo. P. Smith Supt., Henry M. Fales.

TROY, *Rensselaer Co.* (Pop., 56,747; est., 60,000.) On Hudson river, opposite mouth of the Mohawk and at the head of steam navigation. Along the river land is level, then rises abruptly 150 ft. above tide. Manufactures iron, steel, stoves, collars, and cuffs and has large river trade.

History.—Built in '33 and rebuilt in '80, by city. Engr. of new works, David M. Greene.

In '29, the population being 10,000, a water company was chartered, but taking no action its charter was purchased in '33 by the town for $173.34, and works built. The supply was Piscawen creek, having a drainage area of two miles. The first dam was of logs and stone, forming an impounding reservoir from which water was passed through a settling and intermediate basin to a reservoir covered with a brick arch and paved with brick laid in cement. In '56 the old dam was replaced by one of stone, two 20-in. pipes leading from it to reservoir, one near bottom, and one 3 ft. above, and a 20-in. main leading to the city. The distributing reservoir was 304 by 18.3 ft., by 8.3 ft. deep, was 110 ft. above river, 62 ft. above and 1,800 ft. from main street of town. In '67 this reservoir leaked so badly that a strong puddle was substituted in place of stone wall on west side.

In '59 a storage reservoir was built on Piscawen creek, near Oakwood avenue. Dam is of earth faced with 18-in. stone wall, has puddle wall in center, is 49 ft. high, 270 ft. long on top, and has overflow cut in rock south of dam. At first, two 12 and one 20-in. pipes were laid through and beneath the dam in rock trench, and surrounded with puddle, but in '79 a brick culvert was built through the dam and the effluent pipes placed in it.

In '62 a second storage reservoir was built on Piscawen creek near Cemetery avenue. It was formed of clay, sand and earth puddle, the latter being 20 ft. wide at bottom and 16 on top. The bank is 43 ft. high. The embankment of Cemetery avenue formed the back filling, and the effluent pipe was laid through it in a brick culvert, at the upper end of which was a brick well, 18 by 20 ft., coped with stone, and having a dividing wall. The walls were 4 ft. thick at the bottom, 2½ at top, and in the well were 4 gates at different levels. This reservoir covers 34 acres, and has cap. of 250,000,000 galls.

There is also a third storage reservoir on Piscawen creek, 4 miles from city, similar to the others in construction, with a depth of 20 ft., and cap. of 180,000,000 galls. Its dam is 30 ft. high, and culvert for effluent pipe oval, 6½ ft. in diam. and 125 ft. long.

A 1,000,000 galls. reservoir has been built for use in case of emergency, just below the distributing reservoir.

Before the completion of the Oakwood avenue storage reservoir, in '59, it became necessary to supplement the Piscawen supply by pumping from the "Hydraulic Canal." This was kept up till the new works were built. In the time, Holly rotary and Flander's water-power, and Knowles steam pumps had been used.

The above resources not being sufficient, new works were built in '79-80, as described below.

Water Supply.—Piscawen creek, by gravity from five artificial storage reservoirs; Hudson river, pumping to Oakdale reservoir on above creek. Piscawen creek has a drainage area of 1,363 acres. The Hudson river supply is taken three miles above Troy, at Lansinburgh.

Storage Reservoirs.—Described above.

Inlet Piers.—Of stone masonry, 356 ft. from pump-well, 250 ft. from original Hudson river shore line, in 6½ ft. of water at low stage. Founded on rock, 55 ft. long, 20½ ft. wide and bottom carried up 26½ ft., or 5 ft. above highest known freshet level and has brick gate-house on top. Well in center is 6 ft. sq., has two influent openings, 3 ft. sq. one midway between bottom and low water, other midway between bottom and high water. Flow is regulated by gates, or screens, placed in pockets, in side of well, operated by hand wheels in gate-house. Wall is carried down 15 ft. in rock, where it meets tunnel to well. In view of possible destruction to State dam a 30-in. pipe is laid out to old channel of river.

Tunnel.—From inlet pier to pump-well, 356 ft., in solid rock, 7½ ft. wide, 4½ ft. high, with ascending grade 1 ft. in 140.

Pump-Well.—Under engine-house, 8 by 12 ft. by 45 ft. below surface of ground, or 38 ft. below cellar bottom. Walls are of solid rock-dressed masonry, 2 ft. thick, with coping 14 ft. below low water in river.

Pumping Machinery.—Dy. cap., 6,500,000 galls.; two sets of quadruplex engines driving Holly pumps; steam cylinders are 27 in. in diam by 36-in. stroke, and pumps 17¾ in. in diam. by 36-in. stroke.

Force Main.—Starts from engine house in two 18-in. branches, which unite outside in a 30 in. main, 16,000 ft. long, terminating in a masonry wall at Oakwood Avenue reservoir. The main has several curves of 10 ft. radius.

High Service Reservoir.—Cap., 2,500,000 galls.; built on Piscawen creek, in connection with new supply. Triangular, with flow line 382 ft. above tide-level, with main dam, compartment and head walls. *Main dam* is of earth, 380 ft. long, 15 ft. wide on top, 19 ft. high and 4 ft. above high water, with inner slope 2 to 1, outer, 1½ to 1, and having puddle wall 6 ft. wide on top, increasing in width 1 ft. for each 6 in depth, carried into rock bed. There is a waste-weir and a 20-ft. masonry spillway. *Compartment wall* is 120 ft. above main dam, of rubble masonry in cement, 110 ft. long, with spillway 57 ft. long. *Head wall* is 270 ft. above main dam, and 60 ft. from head of pond, of masonry, 33 ft. long on top, with 27-ft. spillway. The gates in the well and gate-house are so managed that water can be drawn only from upper 6 ft. of reservoir, though the total depth of water is 15 ft. A 20-in. distributing main leads from this reservoir to city.

Distribution.—*Mains*, c. i., 53.18 miles. *Services*, c. i., lead. *Taps*, 5,250. *Meters*, 46. *Hydrants*, Bailey, Ludlow, 600. *Pressure gauge*, Edson.

Consumption, 8,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $1,171,692. Debt, $116,000. Int., 4%. Sinking fund, $36,200. Ann. op. exp., $50,871. Ann. rev.: consumers, $89,420; city, none.

Management.—Five Commrs. Prest., Joseph Fales. Clerk, Jno. G. Ogden. Pumping Engr., Sifroid Soucy. Keeper of the reservoirs, Jno. Hare. Supt., Palmer H. Baermann.

UNADILLA, *Otsego Co.* (Pop., 922; est., 1,500.) On Susquehanna river. Has some manufactories. Settled before Revolutionary War, organized in 1792, incorp. a village in '27.

History.—Present works completed in '86; works for fire protection built in '80 by S. S. North. Des. Engr., Peter Hogan.

Water Supply.—Springs, by gravity from collecting reservoirs.

Reservoirs.—Cap., 2,000,000 galls. The first was 100 by 56 ft., by 7 ft. deep, constructed in embankment, with puddle walls, and was 150 ft. above main street of village.

Filter.—Of sponge, at reservoir.

Distribution.—*Mains*, c. i., 2 miles. One mile of Asphalted w. i. pipe was laid, but proving unsatisfactory was replaced by c. i. *Services*, w. i., lead. *Taps*, 41. *Meters*, 1. *Hydrants*, Mathews, 13. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, not given. No debt. Ann. op. exp., none in '88. Ann. rev.: consumers, not given; city, $650. Hydrant rental, $50.

Management.—Owner, S. S. North. Supt., D. H. Loomis.

UNIONVILLE, *Kings Co.* See Gravesend.

UTICA, *Oneida Co.* (Pop., 33,914; est., 45,000.) On Mohawk river. Manufactures iron, shoes, clothing, cotton and woolen goods. Founded in 1757; incorp. a village in 1798, a city in '52.

History.—Present works built in '49 by Utica Water-Works Co. Engr. and Contr., Thos. Hopper.

From '02 to '24 a part of the village was supplied with water for domestic use by the Utica Aqueduct Co. Their capital stock was $5,000, and the supply was from springs, through wooden logs.

From '05 to '22 the village was protected from fire by three wells, fitted with pumps, the work being done by village trustees.

From '24 to '34 the only water supply of the village was from private wells. In '26 the "Utica Aqueduct Company in the Co. of Oneida" was incorporated but did no work. In '32 the "Utica Water-Works Association was formed, and from '34 to '50 furnished spring water by gravity. In '45 the Legislature authorized Edward Broadhead to supply Utica with water. He made plans and surveys for a supply through a 6 in. log aqueduct from Starch Factory creek, but receiving little encouragement abandoned the project. The present company was incorporated in '48.

Water Supply.—Surface water, by gravity from impounding to distributing reservoir.

Reservoirs.—Combined cap., about 800,000,000 galls., there being three storage and one distributing reservoirs. The first storage reservoir took the drainage from about 16 acres of broken land, having a slate substratum. It has an area of 10 acres and a depth of 30 ft. There was a distributing reservoir used in connection with it, but this has been abandoned. Water from the first reservoir flows in a stream about 2½ miles, passing over Buttermilk falls, of 60 ft., flowing underground for 360 ft., and entering the second reservoir, built in '54, with banks 50 ft. high, a cap. of about 40,000 galls., and covering 7 acres. In '68 a distributing reservoir was built a mile from, and 260 ft. below, the second storage reservoir, covering 11 acres, having a depth of 22 ft., a cap. of 40,000,000 galls., and being 80 ft. above highest point in city. At this time the aqueduct capacity to the city was increased from one 10-in., to two 12-in., conduits. In '73 and '74 a storage reservoir of about 300,000,000 galls. cap., and 30 acres area was constructed. Its banks are 300 ft. wide at bottom, 20 at top, and 70 ft. high. Connection is made with the distributing reservoir by a 20-in. pipe, reduced to 12-in. In '85 work was begun on a fourth storage reservoir, which was finished in '86. Its cap. with banks 47 ft. high is about 400 000,000 galls. When necessary the banks will be raised an additional 20 ft.

Distribution.—*Mains*, c. i., 50 miles. *Services*, lead. *Taps*, about 2,600. *Meters*, about 1,500. *Hydrants*, Mathews, Galvin, Ludlow, Bigelow, about 325. *Valves* kind, do.

Consumption, 3,000,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 130 lbs.

Financial.—Capital stock, $500,000. Bonded debt, (in '86) $150,000. Int., 4, 5 and, 7%. Under a contract made in '68, city pays $10,000 yearly for all purposes, one-half of all taxes above $1,000 on company's property within city limits, 7% annually, upon cost of all extensions beyond a certain limit, and furnishes hydrants.

Management.—Prest., Thos. Hopper. V. Prest., A. G. Brower. Secy., J. K. Chamberlayne. Treas., Publius V. Rogers. Supt., W. Peatt.

NOTE:—A historical and descriptive sketch of these works was read before the Oneida Historical Society in '86, by the President, Projector and Builder of the works, Thos. Hopper, and has been printed in pamphlet form, 20 pp.

WALTON, *Delaware Co.* (Pop., 1,389; est., 2,000.) On Delaware river, in valley about a mile wide, surrounded by steep hills from 400 to 800 ft. high. Settled in 1784; incorp. in '51.

History.—Built in '79 by Walton Water Co. Engr., Wm. B. Rider, South Norwalk, Conn.

Water Supply.—Surface water, by gravity from impounding reservoir on stream draining 8 sq m.

Reservoir.—Covers 2½ acres, and is 205 ft. above village.

Dam.—Of earth, 210 ft. long, 18 to 22 ft. high, with inner slope 2 to 1, outer, 1½ to 1, having dry rubble heart-wall, 12 ft. thick at bottom, 5 ft. at top, backed with a 3-ft. wall laid in cement. Lower face of overfall is 60 ft. long, laid up in steps of 1 to 1.

Filter.—In chamber in dam, 4 by 10 ft., by 18 ft. deep, the chamber being in three compartments, separated by wire screens. In the first compartment there is 6 ft.

of charcoal, in the second, 18 ins. of sponge, and from the third water flows to village through 165 ft. of 10, and 8,814 ft. of 8-in. cast-iron pipe. The filter will pass 30,000 galls. a day.

Distribution.—*Mains*, c. i. 6 miles. *Services*, enam. i., galv. i., lead. *Taps*, 175. *Meters*, 3. *Hydrants*, Mathews, 40.

Consumption, not given. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $20,000. Capital stock, $25,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $2,000.

Management.—Prest., Strong Comstock. Treas., Geo. O. Mead. Secy., G. W. Fitch. Supt., J. W. St. John.

WARRENSBURGH, *Warren Co.* (Pop., 748.) On Schroon river. Manufactures leather, pulp and lumber.

History.—Built in '84 by Warrensburgh Water Co.

Water Supply.—Brook, fed by springs, by gravity.

Reservoir.—No data given.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 79. *Meters*, none. *Hydrants*, kind not given, 7.

Consumption, not given. *Pressure*: Ordinary, 110 lbs.

Financial.—Cost, $5,000. Debt, $4,000. Int., 6%. Ann. op. exp., nominal. Ann. rev.: consumers, $800; city, none.

Management.—By Saml. Bates and Supt. Ira Cole.

WARSAW, *Wyoming Co.* (Pop., 1,910; est., 3,000.) On Allen creek, between two ranges of hills, 1,013 ft. above sea-level. Has salt deposits near by, and works them. Settled in '03; incorp. a village in '47.

History.—Built in '70 by Warsaw Water-Works Co. Engr., Jas. O. McClure.

Water Supply.—Springs, by gravity from collecting reservoirs.

Reservoirs.—One 60 ft. sq. by 25 ft. deep, and one 250 ft. sq. by 14 ft. deep.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 300. *Meters*, 4. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 128 lbs. Fire, 128 lbs.

Financial.—Cost, said to be unknown, given as $40,000 in '86. Capital stock, $25,000. Debt, $5,000. Int., 6%. Ann. op. exp., unknown. Ann. rev.: consumers, $3,700: city, none.

Management.—Secy. and Treas., E. H. Morris. No Supt. at time of report.

WARWICK, *Orange Co.* (Pop., 1,043; est., 1,300.) On Mistucken creek, in hilly and rocky country. Settled in 1719; incorp. in '67.

History.—Built in '72 by village. Des. Engr., Chas. Caldwell.

Water Supply.—Surface water, by gravity from impounding reservoir on small stream.

Reservoir.—Is about one mile from, and 150 ft. above village, covers 3.41 acres, and is formed by an earth dam.

Distribution.—*Mains*, w. i. and cement, 4 miles in '82. *Services*, iron. *Taps*, 118. *Meters*, none. *Hydrants*, Ayers are being replaced by Mathews, 33.

Consumption, not given. *Pressure*: Fire, 72 lbs.

Financial.—Cost, $25,000. Debt, $6,000. Int., 5%. Ann. op. exp., $100. Ann. rev.: about $1,000.

Management.—One Commr.: W. A. Hulse.

WATERFORD, *Saratoga Co.* (Pop., 1,822; est., 5,000.) On Hudson river, 4 miles from Troy. Manufactures knit goods, collars, cuffs, stocks and dies, lathes, fire hydrants, valves, steam and hand fire engines, paper and brushes.

History.—Built in '86 by Waterford Water Co., and controlled by Moffett, Hodgkins & Clarke, Watertown, who were Engrs. and Contrs.

Water Supply.—Hudson river, pumping to tank.

Pumping Machinery.—Not given.

Tank.—Not given.

Distribution.—*Mains*, c. i., 6.5 miles. *Services*, galv. i. *Taps*, 266. *Meters*, 45. *Hydrants*, kind not given, 57.

Consumption, 170,000 galls. *Pressure*: Ordinary, 77 lbs. Fire, 150 lbs.

Financial.—Cost, $90,000. Debt, $72,000. Int., 6%. Ann. rev.: city, $2,300. No further data given.

Management.—Supt., W. A. Dennis.

WATERLOO, *Seneca Co.* (Pop., 3,893; est., 5,000.) Manufactures shawls, carriage-wheels, yeast cakes, iron fences, woolen goods, agricultural implements, steam and friction engines, organs and carriages.

History.—Built in '86 by Waterloo Water Co. Eng., W. S. Parker. Contr., Edw. Shanley, New York.

Water Supply.—Seneca river, direct pumping and pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington duplex compound condensing pumps, and two 80 H. P. tubular boilers.

Stand Pipe.—Is 15 ft. in diam. and 130 ft. high; furnished by Ryan & McDonald, Waterloo.

Distribution.—*Mains*, c. i., 9 miles. *Services*, enam. i. *Taps*, 209. *Meters*, 1. *Hydrants*, Ludlow, 50. *Valves*, Ludlow. *Pressure gauge*, Edson.

Consumption, 175,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $100,000. Capital stock, $40,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: not given.

Management.—Prest., Francis Bacon. Secy., A. G. Mercer. Supt., Geo. Clark.

WATERTOWN, *Jefferson Co.* (Pop., 10,697; est., 15,000.) On Black river, which furnishes good water-power used in manufacturing. Settled about 1800; incorp. a city in '69.

History.—Built in '53 by village.

Water Supply.—Black river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 6 000,000 galls.; water-power pumps made by R. D. Wood & Co., Philadelphia, Pa.

Reservoir.—Cap., 3 250,000 galls.; is 150 ft. above river.

Distribution.—*Mains*, c. i., 22 miles; originally w. i. and cement. *Services*, w. i., galv. i. *Taps*, 1,600. *Meters*, 5. *Hydrants*, Holyoke, 110. *Valves*, Eddy.

Consumption, 2 000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $235,000. Debt, $235,000. Int., 3 and 7%. Ann. op. exp., $3,500. Ann. rev.: consumers, $17,000; city, $4,800.

Management.—Five Commrs. Prest., J. C. Knowlton. Clerk, N. B. Wardnell. Supt., A. Salisbury. Report made by Commr. F. A. Hinds.

WATERVILLE, *Oneida Co.* (Pop., est., 3,000.) In township of Sangerfield, in hop-raising country.

History.—Built in '88 by village. Engr., Wm. B. Rider, South Norwalk, Conn. Contr., G. W. White, Pulaski.

Water Supply.—Surface water, by gravity from storage and distributing reservoirs.

Reservoirs.—Cap., storage, 20,000,000 galls.; distributing, 5,000,000 galls. Water passes by overflow from storage to secondary reservoir, from here through filter dike to clear water basin or distributing reservoir.

Distribution.—*Mains*, c. i., 8 miles. *Services*, c. i. Pipe furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and specials by Builder's Iron Foundry, Providence, R. I. *Taps*, 60. *Meters*, not given. *Hydrants*, R. D. Woods & Co.'s, 48. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 90 lbs.

Financial.—Cost, $50,439. Bonded debt, $50,000. Int., 4%. Further data not yet known.

Management.—Four Commrs. Prest., Ira. D. Brainard. Secy. and Treas., S. S. Bissell.

WAVERLY, *Tioga Co.* (Pop., 2,767; est., 4,000.) In rolling country, a small stream flowing through village. Settled in '40; incorp. a village in '55.

History.—Built in '80 by Waverly Water Co. Engr., Peter Hogan, Albany.

Water Supply—Surface water and springs, by gravity from impounding reservoir receiving drainage from about 2 sq. m.

Reservoir.—Cap., 58,000,000 galls.; covers 10 acres and is 100 ft. above village. Is formed by earth dam 150 ft. long and 50 ft. high, with outer slope 1½ to 1, inner, 2 to 1, having masonry heart-wall 8 ft. thick and 35 ft. high.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 350. *Meters*, 5. *Hydrants*, Mathews, 25.

Consumption, 500,000 galls. *Pressure*: Ordinary, 87 lbs. Fire, 87 lbs.

Financial.—Cost, (in '86) $60,000. Ann. op. exp., $1,800. Ann. rev.: city, $1,875 for hydrant rental, $75 each.

Management.—Prest. and Treas., J. L. Sawyer. Secy., J. B. Floyd. Supt., A. J. Vanatta.

WELLSVILLE, *Alleghany Co.* (Pop., 2,049.) On Genesee river, and has tanneries.

History.—Built in '83 under a 25 years' franchise to W. S. Kuhn of the American Water-Works & Guarantee Co., Pittsburgh, Pa. Engr., C. W. Knight, Rome. Contr. for masonry, Adam Miller & Co., Saratoga.

Water Supply.—Surface water, originally by gravity, now by gravity and direct pumping to reservoir.

Pumping Machinery.—Not given.

Reservoir.—Cap., 7,000,000 galls.; in embankments, with inner slopes riprapped, 14½ miles from, and 185 ft. above village.

Distribution.—(In '86.) *Mains*, w. i., Converse joint, 6 miles. *Services*, w. i. *Taps* 210. *Meters*, none. *Hydrants*, Ludlow, 31. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—(In '86.) Cost, $50,000. Debt, $30,000. Int., 6%. Ann. op. exp., no given. Ann. rev.: consumers, $2,500; city, $1,300 Hydrant rental $40.

Management.—Not given.

WESTFIELD, *Chautauqua Co.* (Pop., 1,924; est., 2,700.) Manufactures leather, flour, paper, woolen goods, baskets, carriages and mowing machines.

History.—Built for fire protection in '79 by village. It is proposed to extend the system in '89, giving better fire protection and a domestic supply.

Water Supply.—Springs, by gravity from reservoir.

Distribution.—*Mains*, iron, 1½ miles. *Hydrants*, kind not given, 12. *Pressure*: 15 lbs.

Financial.—Cost, $5,000. No Debt. Ann. op. exp., $100.

Management.—Village Trustees. Prest., F. B. Brewer.

WEST POINT NATIONAL MILITARY ACADEMY, *Orange Co.* (Pop., 1,500.) On rocky point on west shore of, and 167 ft. above Hudson river. Owned by United States Government, the Academy being established in '02.

History.—Supplied as early as '40. Present system built in '79. Des. Engr., Maj. O. H. Ernst. Const. Engrs., Maj. Raymond and Capt. Tabor, U. S. Corps of Engrs.

Water Supply.—Mountain stream, by gravity from impounding reservoirs. Stream generally dries up in summer.

Reservoirs.—Are from ¼ to 5 miles from the Post; cap., 48,000,000; 300,000; 1,300,000 and 9,000,000 galls. respectively. The larger reservoirs covers about 11 acres, is in the hills, 4 miles from, and 1,000 ft. above river, and water passes from it through a sand and gravel filter and a 6-in. cast-iron siphon, 900 ft. long. The distributing reservoir is 167 ft. above the Post.

Distribution.—*Mains*, c. i., about 7 miles. *Meters*, none.

Consumption, 300,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—Cost, unknown. No debt. Ann. op. exp., about $1,000. Ann. rev.: none.

Management.—Water Supply is in charge of Instructor of Practical Military Engineering, and Post Quartermaster has charge of its distribution. Supt., Capt. Philip M. Price.

WEST TROY, *Albany Co.* (Pop., 8,820; est., 12,000.) On west bank of Hudson river, on low land. The Watervliet U. S. Arsenal was established here in '07. Engaged in manufacturing and lumber trade. Incorp. a village in '36.

History.—Built in '73-6 by West Troy Water-Works Co. Engr., Palmer H. Baermann.

Water Supply.—Mohawk river, pumping to chamber 130 ft. above and ½ mile distant, thence by gravity 5 miles to storage and distributing reservoir. A dam across Mohawk river, 1,200 ft. long, gives a head of 7 ft., used to drive pumps.

Pumping Machinery.—Cap., 1,500,000 galls.; Vergennes water-power pumps.

Reservoirs.—Cap., 70,000,000 galls.; formed by closing a ravine, ¾ mile from village, covers about 13 acres, and is 40 ft. deep.

Distribution.—*Mains*, w. i. and cement, 11 miles. *Services*, lead, iron. *Taps*, 547. *Meters*, none. *Hydrants*, kind not given, 87.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $300,000. Capital stock, $100,000. Bonded debt, $200,000. Int., 6 and 7 %. Ann. op. exp., $5,000. Ann. rev.: consumers, $11,000; city, $10,000. Hydrant rental, $100.

Management.—Prest., J. H. Hodgkins. Treas., J. V. Clarke. Secy., H. B. Armstrong. Supt., C. M. Storer.

WHITEHALL, *Washington Co.* (Pop., 4,270, est., 5,000.) At head of Lake Champlain, at mouth of Poultney river. Engaged in boat-building, manufacturing and lumber trade.

History.—Built in '52, and new works built in '84 by village.

Water Supply.—Springs, by gravity, pumping to reservoir and pumping direct.

Reservoir.—Cap., 5,500,000 galls.; about ½ mile from, and 266 ft. above, village, and is formed by a dam across valley, originally 260 ft. long.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Davidson compound condensing pump.

Distribution.—*Mains*, c. i., 7.9 miles. *Services*, galv. i., lead. *Taps*, 321. *Meters*, 12. *Hydrants*, Mathews, 51. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 115 lbs.

Financial.—Cost, $83,225. Debt, $79,000. Int., 4 %. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,200; city, $2,400.

Management.—Supt., C. M. Hotchkiss.

WHITE PLAINS, *Westchester Co.* (Pop., 2,381; est., 4,500.) Is place of residence for some New York City business men, being 22 miles from that city.

History.—Built in '85 by a private company, and controlled by Moffett, Hodgkins & Clarke, Watertown.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Not given.

Tank.—Not given.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 128. *Meters*, not given. *Hydrants*, kind, not given, 71.

Consumption and *Pressure*, not given.

Financial.—Cost, $120,000. Debt, $86,000. Int., 6 %. Ann. rev.; city, $3,250. No further data given.

Management.—Supt., A. L. Fassett.

WHITESBORO, *Oneida Co.* (Pop., 1,371; est., 1,800.) On Sanquvit creek. Settled in '14; incorp. a village in '30.

History.—Built in '27 by Lyman L. Wight, and owned by him.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Is 10 by 12 ft., by 8 ft. deep.

Distribution.—*Mains*, c. i., 2½ miles; cement pipe was first used, then wooden, then c. i. *Services*, w. i. *Taps*, 32. *Meters*, none. *Hydrants*, 1.

Consumption, not given. *Pressure*: Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Cost, $3,500. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $500; city, none.

Management.—By owner, L. L. Wight.

WORCESTER, *Otsego Co.* (Pop., est., 1,400.) In farming country.

History.—Built in '87 by Worcester Water Co., under 99 years franchise. Engr., Geo. N. Cowan, Stamford. Contr., Francis Leonard, Norwalk, Conn.

Water Supply.—Caryl lake, by gravity. Lake has area of 41 acres.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 20, adding more. *Meters*, none. *Hydrants*, kind not given, 17.

Consumption, not determined. *Pressure*: Ordinary, 70 lbs. Fire, 90 lbs. Regulated by Ross pressure valve.

Financial.—Cost, $34,000. Capital stock, $24,000. Bonded debt, $10,000. Total debt, $12,775. Int., 6 %. Ann. op. exp., $90. Ann. rev.: consumers, $180; city, $700. Hydrant rental, $41.18.

Management.—Prest., Geo. Hardy. V. Prest., H. H. Smith. Secy., S. W. Ferguson. Treas., M. H. Nichols. Supt., J. T. Hardsall.

YONKERS, *Westchester Co.* (Pop., 18,892; est., 26,000.) On Hudson river adjoining New York, but 17 miles from New York city hall. The Saw Mill creek empties into the Hudson here, flowing through middle of city, affording good water power, which is used in various manufactories. Many New York City business men reside here.

History.—Built in '76 by city. Engr., Wm. W. Wilson, deceased. Consulting Engineer, Gen. Geo. S. Greene. In '73 a 2,000,000-gall. reservoir, supplied by springs, had been built and pipes laid in business part of city, for fire protection. This is now known as Lake Avenue distributing reservoir. A part of the 24th ward of New York City is supplied from these works. In '81 the amount furnished was less than 15,000 galls. a day.

Water Supply.—Sprain and Grassy Sprain brooks, pumping from impounding to distributing reservoir, and direct pumping. Valleys of both streams are underlaid by primitive rock. Sprain brook has a drainage area of 2.75 sq. m., and the Grassy Sprain, of 2.12 sq. m. A small masonry dam across Sprain brook diverts it into a canal, 5 ft. wide at bottom, with stone paved slopes of 1½ to 1, 4.5 ft. deep, and 3,330 ft. long, emptying into the Grassy Sprain storage reservoir. There are several vertical falls in the lower part of the canal, intended for aeration of the water.

Grassy Sprain Storage Reservoir.—Cap., 400,000,000 galls.; is 9,000 ft. long, has area of 104 acres, average depth of 12.5 ft., and is 113 ft. above tide level. Contrs. for reservoir and dam, Davis & Kelly.

Dam.—Forming above reservoir, 400 ft. long, 26 ft. high above stream, on rock at one end, and hardpan at other, with puddle heart-wall, which is protected, on hardpan, by two rows of sheet piling, 15 ft. apart, driven from 10 to 30 ft. in gravel. Under heart-wall on rock is a rubble masonry core, 3 ft. sq., and on hardpan the puddle is carried down in a trench, and in depressions below natural surface is put on a bed of concrete, 2 to 4.5 ft. thick. In quicksand an additional line of piling was driven 5 or 6 ft. into gravel, and its top enveloped in concrete. A 48-in. pipe, resting on piles and enveloped in masonry, is laid beneath the dam. There is a gate-house at each end of the dam, and at the west end a 25-ft. waste-way, built on the rock. There has always been some leakage under and about the dam, appearing a short distance below.

Filter.—Of gravel, built under a bridge, a short distance above dam, on a road embankment across reservoir making a lower basin of six acres. All water reaching this basin passes through filter, or under bank.

Pump-Well Conduit.—Of 24-in. cast-iron, 3,552 ft. long.

Pumping Machinery.—A 2,500,000-gall. Wright, and 4,000,000-gall. Worthington pump for low service, and a 1,000,000-gall. Worthington for high service. Feb. 20, '80, owing to the sticking for an instant of the steam valve of the engine, steam at full pressure was admitted to the cylinders, increasing the pressure on the force main sufficiently to blow out the air-valve at its summit.

Force Main.—Is of 18-in. cast-iron, rising 225 ft. in 4,000 to top of Fort Field Hill, where there is a self-acting valve, then descends for 4,525 ft. to Lake Avenue distributing reservoir.

Lake Avenue Distributing Reservoir.—Cap., 4,000,000 galls.; is one mile from, and 297 ft. above, city.

High Service Tank.—Cap., 40,000 galls.; is placed in an octagonal brick tower, 98 ft. high, the bottom of the tank being 418½ ft. above tide-level. The tank is 18½ ft. in diam. by 31 ft. high, of boiler iron ½ in thick at bottom and ¼ in. at top. It is placed on a floor of double I beams sustaining a weight of 3,800 lbs. per sq. ft. Contr. for tank, David M. Nichols, New York; for other work, Dennis Murphy, Yonkers.

Distribution.—*Mains*, c. i., 33.4 miles. *Services*, lead. Since '74 mains have been coated with Dr. Augus Smith's preparation. Mains are always tested for leaks, under full head, before trench is filled. In '79 a joint started in an 18-in. main, permitting a jet of water to escape under 85 lbs pressure, causing the earth around to act as a sand blast, and wearing a hole in the spigot end of the pipe in front of the jet. *Taps*, 2,123. *Meters*, 1,538; mostly Crown, with some Union, Rotary, Worthington, Gem, Empire, Equitable and Union Duplex. *Hydrants*, Mathews, 372. *Valves*, McLean. *Pressure Gauge*, Edson.

Consumption, 1,565,600 galls. *Pressure*: Ordinary, 130 lbs. Fire, 150 lbs.

Financial.—Cost, $828,750. Debt, $785,000. Int., 4 to 7 %. Sinking fund, $36,150. Ann. op. exp., $20,965. Ann. rev.; consumers, $52,230; city, $10,770. The sum of $5,083 was received from New York City for water furnished the 24th Ward.

Management.—Five Commrs. Prest., Rudolph Eickemeyer. Treas., Jacob Reed. Clerk and Supt., Jos. A. Lockwood. Pumping Engineer., Wm. H. Baldwin

Water-Works Projected with Fair Prospects of Construction.

ADDISON, *Steuben Co.* (Pop., 1,596; est., 2,500.) On Canisteo river. Has various wood-working shops, boot and shoe factories, tanneries, foundry, and flouring, woolen and saw mills.

Proposed System.—The Addison Water-Works Co. propose to complete works June 1, '89, pumping the supply from wells to reservoir. Estimated cost, $40,000. It is not stated whether capital for construction has been secured. Prest., E. M. Weller. Treas., H. C. Hitchcock. Report made Sept., 29, '88.

Present Supply.—River, creek and cisterns. Town Clerk, W. B. Clark.

AMENIA, *Dutchess Co.* (Pop., est., 800.) Manufactures condensed milk, sash and blinds.

Proposed System.—The American Water Co. propose to pump from gang wells to reservoir, by a 30-ft. Halladay wind-mill. Reservoir to be dug in solid rock, 40 ft. in diam. and 30 ft. deep, to be 800 ft. from village, and 130 ft. above highest land in it. A pumping engine may be provided for use in case of emergency. Jno. R. Thompson has made surveys, and the Amenia Steam Heating Co. will have controlling interest and put in the work. Cost will be about $8,000. Report made by Jno. R. Thompson.

Present Supply.—None for general use.

BABYLON, *Suffolk Co.* (Pop., est., 2,500.) On Great South Side bay, Long Island, 35 miles from Brooklyn. Summer resort, and engaged in fish, oyster and wild fowl business.

Proposed System.—The Long Island Water-Works Co. was organized in '87, the franchise being owned by Moffett, Hodgkins & Clarke, Watertown. Surveys have been made by H. C. Hodgkins, capital for construction has been secured in the form of paid up stock and bonds, and it is proposed to complete the system in '89, the above firm to do the work. Water will be pumped to stand-pipe from a caisson, or gallery, and the works will cost about $50,000. Frank Watts is Chairman of Water Board. Moffett, Hodgkins & Clarke should be addressed for further information.

Present Supply.—No system, water being taken from two ponds, two streams and 15 large wells. Town Clerk, Jos. Moore.

CARTHAGE, *Jefferson Co.* (Pop., 1,912; est., 3,000.) On Black river, 16 miles from Watertown. Engaged in manufacturing.

Proposed System.—Water to be taken from Pleasant lake, mode not given, with 6 miles of mains and 60 hydrants, at an estimated cost of $75,000. The project is backed by H. Hungerford, New York, and if carried through will probably be by Carthage Water Supply Co., not yet formed. A vote was to be taken by town Sept. 29, '88, and report by Wm. B. Kelser, Village Clerk, stated that it would be defeated.

Present Supply.—Fourteen cisterns, filled from Black river.

CASTILE, *Wyoming Co.* (Pop., 965; est., 1,200.) Engaged in milling, and manufacturing salt and farm implements, also has large water cure establishment.

Proposed System.—A private company, name not given, propose to build works in '88, pumping supply from springs to reservoir. Estimated cost $12,000. Capital for construction had not been secured in Mar., '88, and an unofficial report in Aug., '88, states that the company is not organized, but will soon be. Address J. H. Van Ansdale.

Present Supply.—None, save from wells, cistern and stream. Town Clerk, A. B Smith.

CUBA, *Allegany Co.* (Pop., 1,257; est., 1,500.) In an agricultural district.

Proposed System.—Water to be taken by gravity from reservoir on stream, two miles from, and 170 ft. above village, at an estimated cost of from $30,000 to $35,000. Works probably to be owned by village and money to be raised by village bonds. The proposition was voted down in spring of '88, but in following Sept. another vote was to be taken with much better prospect of success. Address, I. N. Sheldon.

Present Supply.—Eight wells. Town Clerk, E. A. Bartlett.

ELLICOTVILLE, *Cattaraugus Co.* (Pop., 748; est., 1,000.) In agricultural district.

Proposed System.—Springs, on surrounding hills, by gravity. Works to cost from

$3,000 to $5,000. No capital raised or definite decision made as late as Sept. 22, '88. Report made by M. N. Kiernan.

Present Supply.—Wells. Village Clerk, E. S. King.

WATKINS, *Schuyler Co.* (Pop., 2,716; est., 5,000 to 6,000, varying from Winter to Summer.) On Seneca lake. Watkins Glen, located here, is annually visited by from 75,000 to 80,000 people.

Proposed System.—Water to be pumped from Seneca lake to reservoir, and direct to village, at an estimated cost of $50,000. Works probably to be owned by village. Surveys made by Carrol Ph. Bassett, Newark. At a special election, June 4, '88, the project was defeated, but the present officers remain in power for four years, and further attempts will be made. The Prest. of the organization is Fred Davis, Jr., and Wm. N. Love can also give information.

Present Supply.—Wells, 7 cisterns and springs on sidehill. Town Clerk, E. A. Gillett.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Bowery Bay, *Queens Co.*; Cazenovia, *Madison Co.*; Coxsackie, *Greene Co.*; Chautauqua, *Chautauqua Co.*; Franklin, *Delaware Co.*; Islip, *Suffolk Co.*; Lowville, *Lewis Co.*; New Hartford, *Oneida Co.*; Otsego, *Otsego Co.*; Shushan, *Washington Co.*; Whitestone, *Queens Co.*

NEW JERSEY.

Water-Works Completed or in Process of Construction.

ASBURY PARK, *Monmouth Co.* (Pop., 1,640; est., 3,500.) Faces Atlantic Ocean, and is a noted summer resort.

History.—Put in operation June 30, '86, but under construction, '85-8. Built by village. Engr., Isaac S. Cassin, Philadelphia, Pa. Contr. for buildings, S. W. Kirkbride.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Two 500,000-gall. Holly pumps.

Stand Pipe.—Made by R. Tippett's Sons, Harrisburg, Pa.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. Pipe and specials furnished by Ormrod, Fisher & Co., now Donaldson Iron Co., Emaus, Pa.; Mellert Foundry & Machine Co., Reading, Pa.; Union Hydraulic Works, Philadelphia, Pa. *Taps*, 460. *Meters*, 60. *Hydrants*, Cassin, 60. *Valves*, kind, do.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Bonds had been issued, in Apr., '88, to the amount of $92,000. Int., 5%. No further data given.

Management.—Commrs. Supt., G. H. Coffin.

ATLANTIC CITY, *Atlantic Co.* (Pop., 5,477; est., 8,000.) On island separated from mainland by 5 miles of marsh land. Engaged in oyster industry. Settled and incorporated as a watering place in '82.

History.—Built in '83 by Atlantic City Water-Works Co., under 99 years' franchise. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., E. Graves. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Wells and streams, pumping to stand-pipe. Well is 25 ft. in diam. and 26 ft. deep and connected by 500 ft. of 24-in. earthen pipe with a creek.

Pumping Machinery.—Worthington pump, dy. cap., 3,000,000 galls.

Stand-Pipe.—Is 25 ft. in diam. by 132 ft. high. In erecting the stand-pipe a float was placed inside, and water pumped in as each ring was added, the float serving as a platform for the workmen.

Distribution.—*Mains*, c. i., 14½ miles. *Services*, w. i. *Taps*, withheld. *Meters*, do. *Hydrants*, R. D. Wood & Co.'s, 150. *Pressure gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Capital stock, $250,000. Bonded debt, $250,000. Int., 6%. Hydrant rental, $50. Further data withheld.

Management.—Prest., Walter Wood. Treas., J. W. Moffly. Supt. and Secy., Geo. T. Prince.

BAYONNE CITY, *Hudson Co.* (Pop., 9,372; est., 18,000.) On tongue of land extending south from Jersey City, with New York bay on the east, Newark bay on the west, and Kill von Kull on the south. Includes Pamrapo, Bayonne, Centreville and Bergen Point. Place of residence for many New York City business men

History.—Supplied in '82, plant owned by city.

Water Supply.—Jersey City Water-Works.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 525. *Meters*, 500. *Hydrants*, Jonson, 72. *Valves*, Jonson.

Consumption, 1,000,008 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $131,000. Debt, $131,000. Int., 5%. Ann. op. exp., $4,000. Ann. rev.: consumers, $50,000; city, none.

Management.—Supt., M. O'Connor.

BELVIDERE, *Warren Co.* (Pop., 1,773; est., 2,000.) On Pequest river, near its junction with the Delaware, in rolling country. Has water-power used in manufacturing.

History.—Built in '77-8 by Belvidere Water Co. Des. Engrs., J. A. Cloud and E G. Weir, the latter of Belvidere. Const. Engr., Jno. H. King, the present Supt. Contr., Conrad Miller, Blairstown, N. J. Sub-Contr., Geo. I. Gardner, Belvidere.

Water Supply.—Delaware river, pumping to stand-pipe.

Pumping Machinery.—Blake duplex, dy. cap., 1,000,000 galls.

Stand-Pipe.—Made by Barber & Son, Allentown, Pa.; 6 ft. in diam. and 160 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. Pipe and special furnished by Jno. J. Fisher, Allentown, Pa. and Warren Foundry and Machine Co., Phillipsburg. *Taps*, 161. *Meters*, none. *Hydrants*, Chapman, 18. *Valves*, furnished by B. E. Lehman, Bethlehem, Pa.

Consumption, 50,000 galls. *Pressure*: Ordinary, 77 lbs. Fire, 77 lbs.

Financial.—Cost, $23,500. Capital stock, $23,500. No debt. Ann. op. exp., $1,400. Ann. rev.: consumers, $2,400; city, $600.

Management.—Prest., D. C. Blair. Secy. and Supt., Jno. H. King.

BLOOMFIELD, *Essex Co.* (Pop., 5,748; est., 6,500.) Engaged in manufacturing, and is place of residence for New York City and Newark business men.

History.—Supplied from East Orange by the Orange Water Co., date not given, but sometime since '82. No further data can be obtained.

BOUND BROOK, *Somerset Co.* (Pop., est., 1,500.) On Raritan river. Has large lumber trade and woolen and other manufactories.

History.—To be finished Nov. 1, '88, by Bound Brook Water Co. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Middle brook, by gravity.

Reservoirs.—Cap., about 10,000,000 galls.; one covering one acre and another covering 6 acres.

Distribution.—*Mains*, c. i., 2 miles.

Pressure: Ordinary, 45 lbs.

Financial.—Cost, est., $30,000. Capital stock, $40,000. No debt. Ann. op. exp., est., $1,800. Ann. rev.: consumers, est., $3,500, including railways; city, est., $300.

Management.—Prest., Jas. M. Thompson. Secy. and Treas., W. B. R. Mason. Mgr., Sylvanus Ayers, Jr.

Not completed at time of report.

BORDENTOWN, *Burlington Co.* (Pop., 4,258; est., 5,000.) On Delaware river on ground about 60 ft. above river. Engaged in manufacturing. Settled early in last century.

History.—Built in '56 by Bordentown Reservoir and Water Co. Engr., Jas. W. Allen. In Jan., '83, the building belonging to these works were burned and the pumping machinery ruined.

Water Supply.—Delaware river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington compound duplex pump, with steam cylinders of 20 and 14-in. diam. and water cylinder of 10-in diam., all of 9-in stroke. Lifts water to reservoir 100 ft. above river through 5,400 ft. of 6-in. pipe.

Reservoir.—In excavation and embankment, cap., 684,466 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services* and *Taps*, not given. *Meters*, 7. *Hydrants*, R. D. Wood & Co.'s, 42.

Consumption, not given. *Pressure*: Ordinary, 33 lbs. Fire, 80 lbs.

Financial.—Original cost, $40,000. Capital stock, (in '82.) $30,000. Debt, $6,300. Int., 6 %. Ann. rev.: consumers, not given; city, $606. Hydrant rental, $14.29.

Management.—Prest., W. Steele. Treas., J. B. Woodward. Supt., Jno. M. Steele.

BRIDGETON, *Cumberland Co.* (Pop., 8,722; est., 11,000.) On both sides Cohansy river, 37 miles from Philadelphia, in gently undulating region. Manufactures glass, iron and nails.

History.—Built in 77-8 by village. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—East lake, springs and wells, pumping to reservoir. The lake has an area of 30 acres, and its overflow is impounded in a 3,000,000-gall. reservoir. A well, 28 ft. deep by 30 ft. in diam., was dug in '87 and connected with pumps by 275 ft. of 16-in. suction pipe. Contr., J. H. Hanes, Cape May.

Pumping Machinery.—Combined dy. cap., 1,500,000 galls.; one Worthington and one Blake duplex pump.

Force Main.—To distributing reservoir, 2,300 ft. of cast-iron pipe.

Reservoir.—In excavation and embankment, 88 ft. above lower reservoir, 103 ft. above, and one mile from village; is 96 ft. sq. at bottom, 135 at top, 15 ft deep and in two divisions.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i. *Taps*, 1,100. *Meters*, 5. *Hydrants*, 105; Mellert Foundry & Machine Co.'s, Reading, Pa., Union Hydraulic Co.'s, Philadelphia, Pa. *Valves*, kind, do.

Consumption, 250,000 galls. *Pressure*: Ordinary, 26 lbs.

Financial.—Cost, to Feb. 1, '88, $101,625. Debt, $86,000. Int., 6 %. Ann. op. exp., $2,400. Ann. rev.: consumers, $12,000; city, none.

Management.—Water Com. of Common Council. Supt., Timothy Woodruff.

BURLINGTON, *Burlington Co.* (Pop., 6,090; est., 8,500.) On east bank of Delaware river, on low, level ground, 18 miles from Philadelphia. Engaged in commerce and manufacturing. Founded in 1677.

History.—Built in '04 to '77, in the latter year being extended by city with Isaac S. Cassin, Philadelphia, Pa., as Engr.

In '04 an Aqueduct Co. brought water from springs on high ground south of village. The pipes were of wood purchased from city of Philadelphia, where they had been in service many years, and then replaced with iron pipes. They were of 2-in. bore, and the supply was so limited, and the regulations to prevent its use so strict, that a prominent citizen was fined five dollars for giving some of this water to a horse.

In '43 Thos. Dugdale laid iron pipes through several streets and pumped into them from river, by means of a steam pump in a mill owned by him. He provided 25 fire hydrants, free of charge, for the privilege of furnishing water to consumers. In '44 his mill was burned, and he erected another pumping engine and 7 iron tanks, placed 50 ft. above ground on a masonry foundation. The latter have been used ever since. In '48 Mr. Dugdale purchased the property of the Aqueduct Co., and erected an 8 H. P high-pressure engine and a 200,000-gall. pump. In '60 the works passed into the hands of the Burlington Water-Works Co., and in '77 they were purchased by the city and extended.

Water Supply.—Delaware river, pumping to tank, which will be replaced or supplemented by stand-pipe.

Pumping Machinery.—Combined dy. cap., 2,000,000 galls.; Worthington compound condensing, and Holly-Gaskill pump.

Tank.—Cap., 100,000 galls. The new stand-pipe will be of iron, 20 ft. in. diam. and 120 ft. high, placed on a stone foundation. Contr., Morris, Tasker & Co.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 1,550. *Meters*, none. *Hydrants*, Mathews, 104. *Valves*, Eddy.

Consumption, 550,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 65 lbs.

Financial.—Cost, $76,000. Debt, $63,000. Int., 4%. Ann. op. exp., $6,000. Ann. rev.: consumers, $12,000; city, none.

Management.—Five Commrs. Supt., Geo. A. Hallison.

CAMDEN, *Camden Co.* (Pop., 41,659; est., 55,000.) On Delaware river, opposite Philadelphia, on level ground. Engaged in commerce and manufacturing, and is a suburb of Philadelphia. Incorp. a city in '31.

History.—Now owned by city; built in '60 by private company and bought by city in '70. Water was first led to pump-well through 2,880 ft. of wooden conduit, and raised by a Cornish pumping engine and a Whiting pump as auxiliary. In '70 a Worthington high-pressure pump was put in place of the Whiting. There was in the engine-house, a plate-iron stand-pipe, 5 ft. in diam. and 123 ft. high. Engr., H. P. M. Birkinbine, Philadelphia, Pa.

Water Supply.—Delaware river, pumping to reservoir. A stand-pipe for 130 ft. head is being erected in '38.

Pumping Machinery.—Combined dy. cap., 15,000,000 galls.; one 5,000,000 and one 10,000,000-gall. Blake pump. Hilles & Jones boilers.

Reservoir.—Cap., 7,500,000 galls.; is in excavation and embankment, 180 by 344 ft., by 20 ft. deep, with inner slopes 1 to 1, paved with brick. When the works were purchased by city 600 tons of sediment were removed from the reservoir.

Distribution.—*Mains*, c. i., 52.66 miles. In '70 a 30-in. main was laid across Cooper's creek, being placed in a trench, dredged, 200 ft. long and 22 ft. below high water. A flexible joint was used, designed by Jacob H. Yocum. *Services*, lead. *Taps*, 908. *Meters*, 5. *Hydrants*, Galvin, 362. *Valves*, Galvin.

Consumption, 5,267,474 galls. *Pressure*: Ordinary, 20 lbs. Fire, 60 lbs.

Financial.—Cost, $700,000. Debt, $400,000. Int., 4 and 7 %. Ann. op. exp., $20,000. Ann. rev.: consumers, $103,461; city, none.

Management.—Commrs. Chairman, Robert S. Barber. Chf. Engr. and Supt., W. W. Mines. Clerk and Registrar, Wm. B. Doyle.

CAPE MAY CITY, *Cape May Co.* (Pop., 1,699; est., 1,800.) On Atlantic Ocean at the southern point of the State. Summer resort.

History.—Built in '74 by city under direction of City Council.

Water Supply.—Dug wells, by gravity to tanks, with pumping as auxiliary.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls.

Tanks.—Cap., 130,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services* and *Taps*, not given. *Meters*, none. *Hydrants*, Mathews, 75.

Consumption, 100,000 galls. *Pressure*: Ordinary, 24 lbs. Fire, 80 lbs.

Financial.—Cost, $35,000. Debt, $10,000. Int., 5 and 6 %. Ann. op. exp., $1,500. Ann. rev.: consumers, $400; city, $5,600.

Management.—Commrs. Supt., H. F. Douglas.

CHAMBERSBURG, *Mercer Co.* (Pop., 5,437.) A surburb of Trenton, supplied from the Trenton works, and all data included under account of same.

DOVER, *Morris Co.* (Pop., 2,958; est., 4,000.) In Randolph township, 42 miles from New York City. In iron mining district, and engaged in manufacturing.

History.—Built in '87 by Dover Water Co., under a 10 years' franchise. Engr., Isaac S. Cassin, Philadelphia, Pa. A contract for the works was let, but the contractor abandoned his job when about half done.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Cap., 6,000,000 galls. The reservoir is supplied from the springs through 15,321 ft. of terra cotta pipe. The daily yield is 30,000 galls.

Distribution.—*Mains*, c. i., 6.36 miles. *Services*, lead, galv. i. *Taps*, 25. *Meters*, 10. *Hydrants*, kind not given, 50.

Consumption, not determined. *Pressure*: Ordinary, 5 to 90 lbs. Fire, do.

Financial.—Hydrant rental, $40. Fo further data given.

Management.—Prest., Archer N. Martin. V. Prest., Wm. J. Curtis. Secy., Chas. E. Kimball. Supt., Philip J. H. Bassett.

EAST ORANGE, *Essex Co.* (Pop., 8,349; est., 10,000.) On undulating ground, 160 ft. above tide water, 2½ miles from Newark and 40 minutes ride from New York City, being a place of residence for business men from the latter place. Settled about 1666, and set off from township of Orange in '62.

History.—Built in '82 by Orange Water Co., who also supply Bloomfield. The officers of the company served as engineers. The charter is perpetual.

Water Supply.—Springs and wells, by direct pumping. Wells are 24, 50 and 100 ft. in diam., respectively, and from 85 to 103 ft. deep, in sandstone. Water rises 3 ft. above surface of ground.

Pumping Machinery.—Combined dy. cap., 1,500,000 gall. Holly pump of 12-in. diam. and 18 in. stroke, dy. cap., 1,000,000 galls. Worthington pump, dy. cap., 500,000 galls.

Distribution.—*Mains*, c. i., about 50 miles. *Services*, lead. *Taps*,(in '85,) 800. *Meters*, Crown, Equitable, (in '85,) 150. *Hydrants*, Ludlow, 251. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Original cost, $105,000. Authorized capital, $600,000. No debt in '86. Ann. rev.: city, in '85 for hydrants, $15,060. Hydrant rental, $60.

Management.—Prest., F. M. Shepard. V. Prest., J. M. Randall. Treas., J. A. Minott. Secy., F. M. Shepard, Jr. Supt., Geo. P. Olcott.

ELIZABETH, *Union Co.* (Pop., 28,229; est., 35,000.) On Elizabeth river, and south end of Newark bay, on level land about 11 miles from New York City. Engaged in manufacturing and domestic commerce, the business part of the city being known as Elizabehport. Se called Elizabethtown until '52, and ncorp. a city in '65.

History.—Built in '54 by Elizabeth Water Co. under a perpetual charter. Const. Engr., L. B. Battin, the present Chf. Engr.

Water Supply.—Elizabeth river, pumping to reservoir and pumping direct from 200,000,000-gall. impounding reservoir.

Filter.—Water passes to a 2,000,000-gall. basin through sand and charcoal filter of 1,000 cu. ft. cap.

Pumping Machinery.—Worthington and Davidson pumps, combined dy. cap., 7,000,000 galls.

Distribution.—*Mains*, w. i. and cement, 45 miles. *Services*, galv. i. *Taps*, 3,000. *Meters*, 30. *Hydrants*, Ayers, 220.

Consumption, 2,500,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Cost, $1,000,000. Capital stock, $150,000. Bonded debt, $400,000. Int., 7 %. Ann. op. exp., $40,000. Ann. rev.: consumers, $75,000; city, 5,000. Hydrant rental, $25.

Management.—Prest., Jas. Battin. V. Prest., Wm. Stiles. Chf. Engr., L. B. Battin. Supt., Wm. Whelan.

ENGLEWOOD, *Bergen Co.* (Pop., township, 4,076.) A place of residence for many New York City business men, 15 miles from that city.

History.—Supplied by Hackensack Water Co. Reorganized, of Hoboken; date not given, but probably since '82. All data given under Hoboken. Asst. Supt., at Englewood, Saml. F. Gold.

FLEMINGTON, *Hunterdon Co.* (Pop., 1,751; est., 2,000.) Center of peach trade.

History.—Built in '64 by Flemington Water Co.

Water Supply.—Not given.

Distribution.—*Mains*, c. i., 10 miles. *Hydrants*, 13.

Management.—Supt., J. C. Hopewell. No further data given.

GLOUCESTER CITY, *Camden Co.* (Pop., 5,347; est., 5,500.) On Delaware river, below Camden and near Philadelphia. Summer resort, and engaged in manufacturing.

History.—Built in '83-4 by city. Engr., H. P. M. Birkinbine, Philadelphia, Pa. Contr., Jno. E. Esbach. Sub.-Contr. for buildings, Thos. Leeming.

Water Supply.—Springs and Newtown creek, pumping from reservoir to standpipe.

Reservoir.—Cap., 2,000,000 galls.

Pumping Machinery.—Wetherill compound pump, dy. cap., 2,000,000 galls.

Stand-Pipe.—Cap., 145,000 galls.; Contr., Jno. Baisley.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 452. *Meters*, none. *Hydrants*, Adams, 64.

Consumption, 75,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 80 to 90 lbs.

Financial.—Cost, $82,000. Debt, $82,000. Int., 4 and 6 %. Ann. op. exp., $1,908. Ann. rev.: consumers, $2,857; city, none.

Management.—Chf. Engr., Jas. Finley.

GUTTENBERG, *Hudson Co.* (Pop., township, 1,206.)

History.—Supplied by Hackensack Water Co. Reorganized, of Hoboken; date not given, but probably some time since '82. All data included under Hoboken.

HACKENSACK, *Bergen Co.* (Pop., 4,248.) On Hackensack river, 13 miles from New York. Residence of many New York business men.

History.—First supplied in '74: now supplied by Hackensack Water Co., Reorganized, of Hoboken. All data for '88 included under Hoboken.

HACKETTSTOWN, *Warren Co.* (Pop., 2,502; est., 2,600.) On Musconetcong river, in valley between hills 400 to 600 ft. high. Highest elevation in State is within ½ mile of town. Engaged in manufacturing. Settled about 1750; incorp. a town in '53.

History.—Built in '60 by village, under name of Hackettstown Aqueduct Co. Engr., A. R. Day.

Water Supply.—Mountain stream, by gravity.

Reservoir.—Area, ¾ acres; is about 100 ft. above village.

Filter.—Water passes to pipes, from reservoir, through filter of sand, gravel and charcoal.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $54,000. Bonded debt, $53,500. Int., 5, 6 and 7%. Sinking fund, $10,000. Ann. op. exp., not given. Ann. rev.: consumers, $5,000; city, none.

Management.—Prest., S. C. Lanson. Treas., W. S. Pettenhouse. Supt., Wm. Sidner.

HOBOKEN, *Hudson Co.* (Pop., 30,999; est., 38,000. Est., pop. supplied, 75,000.) On Hudson river, opposite New York City, and is a port of entry. Does large business in lumber, coal and oil.

History.—First supplied in '55; in '82 a new system was put in, which is now owned by the Hackensack Water Co. Reorganized, and supplies a considerable territory in Hudson and Bergen Cos., north of Jersey City, from the Hudson river west to and including the Hackensack river valley. Besides Hoboken, water is furnished to West Hoboken, Union Town, Weehawken, Guttenberg, North Bergen, Ridgefield, Englewood and Hackensack. Des. Engrs., Jno. F. Ward, Jersey City and Chas. B. Brush, Hoboken. Const. Engr., Chas. B. Brush. Contrs., Jno. F. Ward; and Myles Tierney, and Jno. W. Rutherfoord, of New York City.

The data given below is for the whole system.

Water Supply.—Hackensack river, pumping to reservoirs and tanks.

Pumping Machinery.—Worthington duplex pump, dy. cap., 16,000,000 galls.

Reservoirs.—Two, cap., 3,000,000 and 15,000,000 galls., respectively.

Tanks.—Three, cap., 150,000, 5,000 and 3,000 galls., respectively. Contrs. for reservoirs and tanks, Smith Bros., and Jno McLaren.

Distribution.—*Mains*, c. i., 78.5 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 5,559. *Meters*, 2,667. *Hydrants*, Chapman, Coffin, Mathews, Galvin, 550. *Valves*, kind, do.

Consumption, 4,250,000 galls. *Pressure*: Ordinary, 35 to 50 lbs. Fire, 50 to 75 lbs.

Financial.—Capital stock, $750,000. Bonded debt, $975,000. Int., 5%. Ann. op. exp., $54,000. Ann. rev.: consumers, $147,750; cities, $2,430. Hoboken free. Union Town, Weehawken and Guttenberg, ; Ridgefield, Englewood and Hackensack, $15.

Management.—Prest., R. W. de Forest. Treas., E. A. Stevens. Secy., Wm. Shippen. Chf. Engr. and Supt., Chas. B. Brush.

JERSEY CITY, *Hudson Co.* (Pop., 120,722; est., 155,000.) On New York Bay and Hudson river, opposite New York City. The average level above high tide for a mile back from the river is 8 ft., then it rises abruptly to a ridge running north and south, 130 ft. above high tide, then descends to near tide level on the west side. Has extensive commerce and manufactories, and some of the largest grain elevators and sugar refineries in the world. Many thousands of people doing business in New York reside here. It was laid out in '04 as Paulus Hook, incorp. as City of Jersey in '20 and as Jersey City in '38.

History.—Built in '52 by city. Engr., Wm. Whitwell. Hoboken was included in this system until about '82, and water is now furnished to Bayonne City and to Kearny township.

Water Supply.—Passaic river, pumping to reservoir. Water is taken from the river at Belleville, about 8 miles from the city, pumped to a receiving reservoir on a ridge near the river, and conveyed thence in pipes across the Newark meadows to distributing reservoirs on Bergen hill, in the city.

Intake Pipe.—Was built of brick to edge of river, then a wooden box extended into the channel, with a gate at the outer end.

Pumping Machinery.—Combined dy. cap., 31,000,000 galls.; Worthington, Cornish and Galloway pumps. The first engine was a Cornish beam, with a steam cylinder 80 in. in diam., and a pump plunger 34¾ in. in diam. with a 132 in. stroke. The ram of this engine was so great that it started nearly every joint in the force main, and in '59 a stand-pipe was built to relieve this, increasing by 75 per cent. the cap. of the engine. In '61, and again in '70, a similar Cornish engine was erected, and in '73 two 8,000,000-gall. Worthington compound duplex pumping engines were purchased for a high service system by direct pumping at Bergen Hill. One of these was erected there in '77 and the other at the Belleville station in '73. The diam. of the high-pressure cylinders was 29 in.; low-pressure, 50¼ in.; pump-plungers, 28 in.; length of stroke, 48 in. In '73 a temporary high service was supplied by a Knowles & Sibley pump. In '71 Cornish engine No. 3 was badly wrecked by the breaking of the valve of the water cylinder. The heavily loaded plunger crushed through the guard blocks, destroying the pump, and the steam piston drove out the cylinder head, the piston passing clear through the cylinder, the rod being badly bent, and all the contiguous valve gearing ruined.

Stand-Pipe.—The one mentioned above was of plate iron, from ⅜ to 7-16 in. thick, with base 6½, and top 4 ft. in diam., and 160 ft. high above ground. Being unprotected, this pipe fell Dec. 1, '69, and was repaired and re-erected. In '71 a second stand-pipe was put up, 15 ft. from the first. It was of plate-iron, ¼ to 7-16 in. thick, secured to the base by flanges, 6 ft. in diam. and 160 ft. high. A silicious composition was applied to the old and new stand-pipes to prevent oxidation, and in '72 a tower was built of brick and brownstone, 210 ft. high, enclosing both pipes.

Receiving Reservoir.—At Belleville, in excavation and embankment, 299 by 368 ft., by 16 ft. deep. Inner slopes are puddled, lined with brick laid on edge in cement, with backing of 18-in. of rubble for 5 ft. below top. In '63 a portion of the lining of this reservoir, 125 ft. long and half as deep as the slope, fell in, leaks having washed out 6 in. of earth beneath, and the reservoir having been suddenly lowered, owing to a break in the main crossing Hackensack river.

Conduit.—Is 22,300 ft. long, of which 17,500 ft. is across the meadows. The first pipe was 20 in. in diam., and across the meadows was laid on plank, covered with muck, topped with gravel and sodded. It crossed the river on piers at the side of the turnpike bridge, there being a 30-in. siphon at the draw, resting on rollers, and having slip joints at the ends. The pipe on the bridge was enclosed in an air-tight box to protect it from freezing. In '62 the conduit had settled in places on the meadows, and in the same year a 36-in. main was laid, the 2,000 ft. of slope from the receiving reservoir to the meadows being of wrought iron and cement, the remaining distance of cast-iron.

Across the meadows, two rows of piles were driven, 3 ft. apart, to solid foundation, cut off 16 ft. below the ground, cross capped with 10 by 12 in. white pine timbers, upon which was laid a brick pier, or wall, 12 by 44 in., by 16 in. high. The pipe is placed on this wall and held in place by a brick wall carried up the side. The main crossed the river beside the old one, the siphon resting on a pile and timber foundation. Owing to settlement this siphon leaked, and in '74 it was removed. In '71 a 36-in. cast-iron pipe, with flexible spherical joints, was laid on the bed of the river—just above the old bridge crossing. In '73 a second 36-in. main was laid, of wrought iron and cement, the foundation across the meadows consisting of two rows of piles 2 ft. apart, capped transversely by timbers 12 in. sq. and 6 ft. long, with 5 stringers, 8 by 10 in. for every 6 ft., covered with plank flooring, the whole securely spiked. On this a brick cradle is built, in which rests the pipe imbedded in 1 in of cement, with an 8-in. arch turned over the pipe, 1 in. of cement intervening, and the whole covered with 12 ins. of earth, sodded. In '81 there were three 36 in. submerged pipes at the river crossing, connected with the 36-in. mains.

Bergen Hill Distributing Reservoir.—Oval, with 12 acres of water surface, an average depth of 15 ft., a cap., of 70,000,000 galls., and a flow line 125 ft. above high tide. Inner slopes are lined with brick, with a course of stone near the flow line, and the bottom is puddled with clay and gravel.

Bergen Hill Storage Reservoir.—Built in '71-4, adjacent to distributing reservoir, with area of 27 acres, and cap. then placed at 167,000,000 galls. It has earth embankments, supported on the outside by masonry walls having a base of 12 ft., an outside batter of 1 in. in 1 ft., and rising by steps on the inside, the top being 3 ft.

wide. The banks are 27 ft. wide on top, with inner slopes of 1½, and 2 to 1, and having a puddle heart-wall 8 ft. wide at base. The bottom of the reservoir is puddled with clay and gravel and the slopes lined with rubble masonry one-third of the way down from the top, the remainder of the slope being unprotected. The reservoir is nearly rectangular, and is divided in the center by a masonry wall, with gates. The reservoir leaked badly in '80, water escaping under the bank, along the natural surface.

Distribution.—*Mains*, c. i., 160 miles. *Services*, lead. *Taps*, 16,936. *Meter,s* 217; first used here in '62. *Hydrants*, Mathews, McLean, Galvin, 1551. *Pressure gauge*, Edson.

Consumption, 16,500,000. *Pressure*: Ordinary, 15 to 60 lbs. Fire, 20 to 70 lbs.

Financial.—Cost, $4,950,000. Debt, $4,838,000. Int., not given. Ann. op. exp., $539,-170. Ann. rev.: consumers, $514.428 city, none.

Management.—Chf. Engr., W. W. Ruggles.

NOTE:—A more extended description of these works is given in *Eng. News*, vol. VIII, p. 226.

EARNEY, *Hudson Co.* (Pop., 777; est., 9,000.) Near Jersey City.

History.—Built in '87 by township.

Water Supply.—Jersey City Water-Works, by gravity from the receiving reservoir at Belleville.

Distribution.—*Mains*, c. i., 9 miles. *Services*, not given. *Taps*, not given. *Meters*, three 10-in. *Hydrants*, Ludlow, 94. *Gates*, Galvin.

Financial.—Cost, $60,000. Ann. op. exp., not given, but 9 cents per 1,000 galls is paid for water.

Management.—Supt., V. G. Hard. Report made by Wm. Davey. No further data given.

LAKEWOOD, *Ocean Co.* (Pop., est., 1,000.) A winter resort for invalids, 22 miles from Long Branch, on South branch of Metedeconk river.

History.—Built in '86 by Lakewood Water Co. Engrs. and Contrs., Ferris & Halladay, Jersey City.

Water Supply.—South branch of Metedeconk river, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls.

Stand Pipe.—Is 20 ft. in diam. by 50 ft high; furnished by Ferris & Halladay, Jersey City.

Distribution.—*Mains*, kind not given, 2.6 miles. *Services*, not given. *Taps*, not given. *Meters*, none. *Hydrants*, Ludlow, number not given. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, not given.

Financial.—No data given.

Management.—Prest. and Supt., Isaac A. Van Hise. Secy and Treas., Saml. D. Davis.

LAMBERTVILLE, *Hunterdon Co.* (Pop., 4,183.; est., 5,000.) On Delaware river, 14 miles above Trenton. Engaged in manufacturing.

History.—Built in '78 by Lambertville Water Co., under a ten years franchise. Engr., Isaac S. Cassin, Philadelphia. Work done by company.

Water Supply.—Swans creek, by gravity. The creek has a drainage area of about 1½ sq. m., of trap formation.

Reservoirs—Two, combined cap., 22,000,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, not given. *Taps*, in '85, 82. *Meters*, none. *Hydrants*, kind not given, 31.

Consumption, 250,000 galls. *Pressure*: Ordinary; 68 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000. No debt. Ann. op. exp., $1,600. Ann. rev.: consumers, $1,600; city, $600. Hydrant rental, about $26.

Management.—Prest., Chas. A. S. Killman. Secy and Treas., Wm. V. Cooley.

NOTE:—A few further items regarding the first reservoir used are given in *Eng. News.*, vol. VIII., p. 328.

LAWRENCEVILLE SCHOOL, *Lawrenceville, Mercer Co.* (Pop., 200.) The school was established in '09.

History.—Built in '84 by Trustees of school. Des. Engr., J. J. R. Croes, New York City. Const. Engr., Frederick S. Odell, New York City. Contrs., Norcross Bros., Worcester, Mass.

Water Supply.—Well, pumping to stand-pipe. The well is 16 ft. in diam. by 23 ft. deep, and the normal level of the water is 3 ft. below the top. For 6 ft. below the surface it is through clay, for the remaining depth, loose sandstone. The well is lined with brick, domed and provided with manhole. This supply is supplemented by storing rain water.

Pumping Machinery.—Worthington, dy. cap., 350,000 galls. When well is full water flows to pump-well, otherwise it is drawn through the suction pipe, 800 ft.

Stand-Pipe.—Is of plate-iron, with lapped joints, riveted and caulked, 10 ft. in diam. and 85 ft. high. Vertical joints are lapped 3½ in. and double riveted for 25 ft. above bottom. Other joints are lapped 2 in. and single riveted. The plates are ¼, 3-16 and ⅛ in., and the bottom ¼ in. thick. The pipe is on a foundation of rubble masonry laid in cement, and is 17 ft. in diam., and 8 ft. deep.

Distribution.—*Mains*, c. i., 0.9 miles. *Services*, lead. *Taps*, 16. *Meters*, none. *Hydrants*, Eddy, 6. *Valves*, Eddy.

Consumption, 7,500 galls. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Cost, $13,500. No debt. Ann. op. exp., $100. Ann. rev.: none.

Management.—Prest., J. T. Nixon. Secy., Chas. E. Green. Supt., E. S. McIlvanie.

Note:—Some additional facts regarding this system are given in "The Water Supply, Drainage and Sewerage of the Lawrenceville School," illustrated. By F. S. Odell. Trans. Am. Soc. C. E., vol. XVI., pp. 66-78.

LONG BRANCH, *Monmouth Co.* (Pop., 3,833; est., 6 500.) Is 14 miles from New York City and has some manufactories. A summer resort.

History.—Built in '77 by Long Branch Water Supply Co.; works for supplying Monmouth Beach were consolidated with these in Nov., '82. Engr., H. P. M. Birkinbine, Philadelphia, Pa.

Water Supply.—Brook and springs, filtered, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., 5,000,000 galls.

Stand-Pipe.—Is 18 ft. in diam., and 80 ft. high.

Distribution.—*Mains*, c. i., 22.5 miles. *Services*, galv. i. *Taps*, 700. *Meters*, none. *Hydrants*, 106; old hydrants, made by J. B. Starr & Sons, Camden, being replaced by Mathews.

Consumption, 520,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $350,000. Capital stock, $250,000. Bonded debt, $100,000. Int., 5 %. Ann. op. exp., not given. Ann rev.: consumers, not given; city, 3,800, for all purposes.

Management.—Prest., Geo. F. Baker. V. Prest., H. E. Gawtry. Treas., E. A. Walton. Secy. and Supt., Whitney Conant.

Note:—For an extended description of the Hyatt Filter plant see *Eng. News* vol. XX, p. 280.

MERCHANTVILLE, *Camden Co.* (Pop., 439; est., 1,200.)

History.—Built in '87-8 by Merchantville Water-Works Co. Engrs., Isaac S. Cassin and Howard Murphy, Philadelphia, Pa. Contr. for buildings, Edw. Tilton.

Water Supply—Stream, fed by springs, pumping to stand-pipe. The daily flow of the stream is 400,000 galls.

Reservoir.—Is 60 by 180 ft., by 10 ft. deep; Contr., Seymour L. Bartholomew, Asbury Park.

Pumping Machinery.—Holly, dy. cap., 50,000 galls.

Stand-Pipe.—Is 8 ft. in diam. and 100 ft. high; made by Chas. E. Tippett, Harrisburg, Pa.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, iron, lead. *Taps*, 121. *Meters*, none. *Hydrants*, Union Hydraulic Co.'s, 20. *Valves*, kind. do.

Consumption, 50,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $32,000. Capital stock, $17,000. Bonded debt, $15,000. Int., 5 %. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200; city, $600. Hydrant rental, $30.

Management.—Prest and Supt., Alex. G. Cattell. Secy and Treas., E. S. Hall.

MILLVILLE, *Cumberland Co.* (Pop., 7,660; est., 8,000.) On Maurice river, on level ground. Manufactures cotton, iron and glass. Settled in 1800; incorp. a village in '66.

History.—Built in '78 by Millville Water Co. Engr., Emile Geyelin. Contrs., R. D. Wood & Co., Philadelphia.

Water Supply.—Maurice river, pumping to stand-pipe from impounding reservoir.

Reservoir.—Formed by dam across river, ¼ mile long, 20 ft. high, 20 ft. wide at top, and 60 ft. at bottom, and covers 1,100 acres.

Pumping Machinery.—Cap., 1,500,000 galls.; pumps of 10 in. bore, driven by water-power, lift water 128 ft.

Stand-Pipe.—Of ⅜ in. plate-iron, 12 ft. in diam. by 130 ft. high.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, in '82, 236. *Meters*, in '82, none. *Hydrants*, R. D. Wood & Co.'s, 67. *Valves*, kind, do. *Pressure Gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 45 lbs. Fire, 53 lbs.

Financial.—Capital stock, $24,900. No bonds. No hydrant rental. No further data given.

Management.—Prest. Geo. Wood. Treas., Walter Wood. Supt., Reuben T. Meredith.

MONMOUTH BEACH, *Monmouth Co.* (Pop., not given.) Near Long Branch, and has summer residences.

History.—The supply for this place was consolidated with the Long Branch Water Supply Co., Nov., '82. All further data included under Long Branch.

MONTCLAIR, *Essex Co.* (Pop., 5,147; est., 7,500.) Is 5 miles from Newark and 14 from New York City. Has some manufactories.

History.—Built in '87 by Montclair Water Co., under a 10 years' franchise. Engrs., Geo. W. Howell and Jas. Owen. Contrs., McNamee & Co.

Water Supply.—Wells, pumping to tank.

Pumping Machinry.—Two Worthington pumps., dy. cap., 500,000 galls.

Tank.—Is 40 ft. in diam. by 30 ft. high.

Distribution.—*Mains*, c. i., 26 miles. *Services*, not given. *Taps*, 400. *Meters*, 12. *Hydrants*, kind not given, 226.

Consumption, 160,000 galls. *Pressure*: 75 to 120 lbs.

Financial.—Cost, $150,000. Hydrant rental, $26. No further data given.

Management.—Prest., Whitney G. Snow. Treas., Jno. R. Bartlett. Supt., Jas. Owens.

MORRISTOWN, *Morris Co.* (Pop., 5,418; est., 8,000.) On Whippany river, a small tributary of the Passaic, in hilly district, chiefly on sandy promontory, with steep slopes. In agricultural and mining district. Settled in 1725; incorp., in '65.

History.—Built in 1799 by proprietors of Morris Aqueduct. Des. Engr., not known. For many years prior to '69 the stock was held by one person, and no records of the works kept.

Water Supply.—Springs, by gravity to distributing, from impounding reservoir. In '65 a pump was erected to take water from river in time of drought.

Impounding Reservoir.—Three, the last being built in '80, and having a cap. of 16,000,000 galls. Engr. of the last one, Geo. W. Howell. The other reservoirs have a cap. of 1,400,000 and 2,000,000 galls., respectively. Water is taken from these reservoirs from near the surface, dropped through fine wire screens, for aeration. In '82, there were two 6-in. mains to the distributing reservoir, one of cast-iron, the other of wrought-iron and cement.

Pumping Machinery.—Worthington, dy. cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 20 miles. *Services*, c. i., galv. i., lead. *Taps*, 800. *Meters*, 250. *Hydrants*, kind not given, 71.

Consumption, 275,000 galls. *Pressure*: Ordinary, 30 to 40 lbs. Fire, do.

Financial.—Cost, $230,000. Capital stock, $125,000. Bonded debt, $125,000. Int., 5 and 6 %. Ann. op. exp., about $6,000. Ann. rev.: consumers, about $16,000; city, $1,800. Hydrant rental, $25.

Management.—Prest., H. C. Pitney. Secy., E. Pierson. Supt., Wm. A. Dunn.

MOUNT HOLLY, *Burlington Co.* (Pop., 4,621; est., 5,000.) On Rancocas creek, on generally level ground, with hills near by. Engaged in manufacturing. Settled in 1680.

History.—Built in '46 by Mount Holly Water Co.

Water Supply.—Rancocas creek, pumping to reservoir, and direct pumping.

Pumping Machinery.—Worthington compound duplex pumping engine, dy. cap. 200,000 galls.

Reservoir.—Cap., 600,000 galls.; is in excavation and embankment, 100 by 50 ft., by 15 ft. deep, with partition wall.

Distribution.—*Mains*, c. i., 8 miles. *Services*, c. i. *Taps*, 450. *Meters*, 2. *Hydrants*, kind not given, 35.

Consumption, 200,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 55 lbs.

Financial.—Cost, $35,000. Capital stock, $7,500. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $5,000; city, $145. Hydrant rental, $5.

Management.—Prest., M. G. Pancoast. Treas., B. Lewis. Secy. and Supt., H. C. Ridson.

NEWARK, *Essex Co.* (Pop., 136,503; est., 160,000.) On west bank of Passaic river, 9 miles from New York. Nearly ¾ of the territory comprised within the city limits is less than 50 ft. above the river. The remaining part rises gradually to an elevation of about 225 ft. Extensively engaged in manufacturing.

History.—Built about 1800 by the Newark Aqueduct Co., and purchased by the city in '60 for $150,000. New works built in '67. Engr., Geo. H. Bailey.

The first supply was from springs in the red sandstone on the hillside, about 80 ft. above the village. Additional springs were taken from time to time, and some wells sunk, both in the rock and in sand. When the works were bought by the city, in '60, the company was supplying about 1,000,000 galls. a day, through 17.51 miles of pipe, none of which was more than 10-in. in diam., while 11.6 miles were less than 4-in. The springs not yielding more than 700,000 galls. daily, the supply was augmented by water from a brook, near the reservoir, and by occasional draughts from the Morris canal. In '62 and '65 new reservoirs were built with a cap. of 12,000,000 galls. In '67 new works were built.

Water Supply.—Passaic river, at Belleville, pumping to reservoir. Above Newark the river has a drainage area of 931 sq. m., favorable to the collection of pure water, but a few miles above the city the river receives the sewage from Paterson and Passaic, and the tide carries the sewage of Newark up the river sometimes further polluting the supply. At first the water filtered through the sand and gravel of the river banks to two basins, each 140 by 340 ft., and 9 ft. below low water in the river, but the yield soon became far less than the consumption, more and more water being drawn directly from the river.

It is stated that the above was the first attempt to use natural filter basins for purifying the water supply of an American city.

In '79 ten 2-in. tubular wells were sunk in the gravel plain near the pumping station and river and yielded 700,000 galls. daily, for 6 months. Soon after 20 more wells, 3-in. in diam., were driven, and in '80 an additional 40. The water obtained from this source was of good quality, and being mixed in nearly equal proportions with the river water greatly improved the supply.

Pumping Machinery.—Combined dy. cap., 26,000,000 galls. and a new 5,000,000-gall. pump has been purchased in '88: the pumps are all Worthington, the first one, erected in '69, has a dy. cap. of 5,000,000 galls.; the second, erected in '71, is a duplicate of the first. In '75 an 8,000,000-gall. compound pump was erected, and a second pump of the same cap. has been put in since.

Reservoirs.—Cap., 20,000,000, 14,000,000, 8,000,000 and 4,000,000 galls. respectively. The receiving reservoir is 6,000 ft. from engine-house, 165 ft. above high water in river, is in excavation and embankment, 210 by 485 ft. at water surface, and 20 ft. deep. Its slopes are lined with a 12-in. stone wall, laid in cement. The 30-in. force main terminates in the center of the reservoir in a bell mouth, 167.5 ft. above high tide. Until '78 the distributing main from this reservoir was of 24-in. pipe, which then became insufficient, and water was pumped directly into the main, under pressure, for a time. In '79 an additional 30-in. main was laid.

In '71-3 a low service reservoir was built about 3 miles from the receiving reservoir, with its surface 114 ft. above tide. It is circular, 460 ft. in diam. by 20 ft. deep. It was built on the site of an old quarry, its bottom being filled to some depth with stone chips, covered with puddle. The latter gave way several times, emptying the reservoir, and repairs being of no use, all the loose material was finally removed to solid rock around the base of the bank, and the trench filled with puddled clay.

About '70 two high-pressure engines were erected for high service supply, pumping from the main pipe to a reservoir built in '71, 225 ft. above tide, 260 by 308 ft., and holding 2,000,000 galls. An annexed stand-pipe enabled the pumps to deliver part of the water 35 ft. higher than the reservoir. This reservoir leaked for 5 years after its construction, and was then repaired and made tight.

In '76, and again in '81, a 3.000,000-gall. Worthington tank engine was erected for high service supply.

Distribution.—*Mains*, c. i., 161 miles. *Services*, lead. *Taps*, 12,207. *Meters*, 432. *Hydrants*, Galvin, 1,341.

Consumption, 12,642,155 galls. *Pressure*: Ordinary, 23 lbs. Fire, 23 lbs.

Financial.—Cost, to '81, $2,671,580, exclusive of real estate, interest and maintenance. Debt, $3,485,000. Int., 4 to 7%. Ann. op. exp., $103,407. Ann. rev.: consumers $315,623; city, none.

Management.—Supt., G. R. Gray.

NEW BRUNSWICK, *Middlesex Co.* (Pop., 17,166; est., 20,000.) On Raritan river, 30 miles from New York City. The crest of a red shale bluff recedes at the site of the city, forming a gently sloping amphitheater, about a mile in diam. Manufactures rubber goods, boots and shoes, buttons, wall paper, hosiery, and machinery. Settled in 1784.

History.—Built in '76 by city. Des. Engr., Willard Smith. Const. Engr., Thos. N. Doughty.

Water Supply.—Lawrence brook, with a drainage area of 43 sq. m., pumping to reservoir.

Dam.—On stream, of stone, 15 ft. high and 184 ft. long, forming an impounding reservoir which also furnishes water-power to drive one of the pumps. The dam was built in 1743, and a second wall built over 100 years ago. Feb. 25, '88, the dam gave way, owing to "inherent weakness," cutting off the city water supply for a time. A new dam is being built in '88.

Pumping Machinery.—Combined dy. cap., 7,900,000 galls.; being 2,400000 gall. water-power, and 3,500,000-gall. Steam Worthington pumps, and 2,000,000-gall. Carr pump. The water-power pump is driven by a 54-in. American turbine.

Distributing Reservoir.—Cap., 15,000,000 galls.; is 130 ft. above pumps, in excavation and embankment, with two basins, each 300 ft. sq. by 15 ft. deep.

Distribution.—*Mains*, c. i., w. i. and cement, 25 miles. *Services*, galv. i., lead. *Taps*, 1,813. *Meters*, 80. *Hydrants*, Ayers, Mathews, Ludlow, 176.

Consumption, 1,083,006 galls. *Pressure*: Ordinary, 45 lbs. Fire, 45 lbs.

Financial.—Cost, $489,240. Debt, $400,000. Int., 6 to 7%. Ann. op. exp., $11,362. Ann. rev.: consumers, $41,028; city, $8,640. Hydrant rental, $50.

Management.—Six Commrs. Prest., Geo. H. Cook. Secy., C. W. Kent. Treas. and Supt., C. H. Cramer.

NEW JERSEY REFORM SCHOOL, *Jamesburg, Middlesex Co.* (Pop., 320.) On 500 acres of land, which is generally level, and was established in '60.

History.—Built prior to '83 by State. Engr., Jas. H. Eastman.

Water Supply.—Springs, pumping to stand-pipe; direct pumping can be used. Formerly water was pumped to two small reservoirs.

Pumping Machinery.—Compound Knowles pump, with 8 in. steam and 12-in. water cylinders and 10½-in. stroke: and for direct pumping in case of fire, single direct acting Knowles pump, with 14-in. steam and 8¾-in. water cylinders, and 12 in. stroke. Cap. of either, not given.

Stand-Pipe.—Is 8 ft. in diam. by 75 ft. high; made by Chas. Tippett, Harrisburg, Pa.

Distribution.—*Mains*, w. i., about 2 miles. *Services*, w. i. *Taps*, 7. *Meters*, not given. *Hydrants*, Eddy, McLean, 7.

Consumption, 25,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 117 lbs.

Financial.—All data said to be unknown.

Management.—Engr.-in-Charge, Jno. D. Bourne.

OCEAN GROVE, *Monmouth Co.* (Pop., est., winter, 1,000; summer, 15,000 to 20,000.) A seaside summer resort.

History.—Built in '84 by Ocean Grove Association.

Water Supply.—Eleven artesian wells, average depth, 450 ft., by pumping to tank.

Pumping Machinery.—Made by Giles & Garrison, dy. cap., 864,000 galls.

Tank.—Iron, 30 by 35 ft.

Distribution.—*Mains*, iron, 12 miles. *Services*, lead. *Taps*, 501. *Meters*, 3. *Hydrants*, kind not given, 27.

Consumption, 376,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, est., $45,000. Further data cannot be separated from other financial statistics of the Association.

Management.—Prest., E. H. Stokes. V. Prest., A. G. Ballard. Treas., D. H. Brown. Supt., L. Rynear.

ORANGE, *Essex Co.* (Pop., 13,207; est., 15,500.) Is 12 miles from New York City, on rolling ground from 150 to 300 ft. above tide-level. Manufactures hats, but is chiefly a place of residence for new York City business men. Incorp. a city in '75.

History.—Built in '83 by city. Engr., Wm. B. Rider, South Norwalk, Conn.

Water Supply.—West branch of Rahway river, by gravity from impounding reservoir. The stream has a drainage area of about 5 sq. m.

Reservoir and Dam.—Reservoir has a cap. of 375,000,000 galls., covers about 60 acres, is about 350 ft. above, and 5 miles from, center of city, and is formed by an earth dam, 875 ft. long, 40 ft. high, having a stone heart-wall. Contrs., Freel & McNamee, Brooklyn, N. Y.

Filter.—Of sponge and charcoal, in gate-house of dam.

Distribution.—*Mains*, c. i., 21 miles. *Services*, lead, galv. i. Pipe laid by F. C. O'Reilly, Orange. *Taps*, 1,300. *Meters*, not given. *Hydrants*, Cassin, Wood, Chapman, Galvin, 200. *Valves*, kind, do.

Consumption, 1,000,000. *Pressure*: Ordinary, 70 lbs.

Financial.—Cost, $400,000. Bonded debt, $400,000. Int., 5%. Ann. op. exp., not given. Ann. rev.: consumers, $15,000; city, none.

Management.—A committee of three from the City Council. Supt., Thos. Dowd.

PASSAIC, *Passaic Co.* (Pop., 6,532; est., 10,000.) On Passaic river, 5 miles from Paterson and 11 miles from New York City. River is dammed at this point, affording water-power used in manufacturing. Ground is level near river, but rises steeply from plain more than 100 ft. Settled in 1680; a rapid increase of the population was caused in '72 by the incorporation of the Dundee Water-Power & Land Co.

History.—Built in '72 by Acquackononk Water Co. Engr., Gen. Thomas D. Hoxsey.

Water Supply.—Vreeland lake, formed by impounding Weasel brook, by gravity, which supply is supplemented by Passaic river, pumping to reservoir.

Impounding Dam.—Is 40 ft. long, 12 ft. high, and a mile from village.

Pumping Machinery.—Carr water-power pump, and Worthington compound pump, and Sullivan's boiler; combined dy. cap., 2,000,000 galls.

Reservoir.—Cap., 1,000,000 galls.; is 125 ft. above river.

Distribution.—*Mains*, w. i. and cement. *Services*, lead. *Taps*, 225. *Meters*, none. *Hydrants*, Mathews, Brown's, 103.

Consumption, about 400,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 35 lbs.

Financial.—Cost, about $150,000. Capital stock, $48,000. Bonded debt, $75,000. Int., 7%. Ann. op. exp., $5,600. Ann rev.: consumers, $15,500; city, $4,731. Hydrant rental, $45, 10 years' contract.

Management.—Prest., Jno. Reynolds. Treas., Jno. J. Brown. Secy., E. T. Bell. Supt., Wm. Paulison.

PATERSON, *Passaic Co.* (Pop., 51,031; est., 65,000.) On Passaic river, 16 miles from New York City, and at point where river breaks through the Watchung or Orange mountain, and falls 80 ft. The water-power afforded by this fall, with a drainage area above 855 sq. m., was purchased in 1791 by the "Society for the Encouragement of Useful Manufactures," and as late as '81 was still controlled by them. Water is directed from the river for manufacturing purposes to a canal by a dam just above the falls. The city has large silk, iron, locomotive and other manufactories.

History.—Built in '56 by Passaic Water Co.

Water Supply.—Passaic river, pumping to reservoirs. The first supply was taken between the "Society's" dam and the falls by the water-power pump. Later, the supply became insufficient, and a small stone dam was built just above the falls, forming a small storage reservoir.

Pumping Machinery.—Combined dy. cap., 18,000,000 galls; water-power and Worthington high-pressure pumps, the latter having a dy. cap., of 3,000,000 and was placed in '78. The original water-power pumps were replaced by three horizontal pumps with an original combined dy. cap. of 16,000,000 galls.

Reservoirs.—Combined cap., 50,000,000 galls. Four, on different levels.

Distribution.—*Mains*, c. i., w. i. and cement, 65 miles. *Services*, lead and galv. i. *Taps*, 5,050. *Meters*, 1. *Hydrants*, Watson Machine Co.'s, of Patterson, 663. *Valves*, kind, do.

Consumption, 8,000,000. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Capital stock, $425,000. Bonded debt, $1,100,000. Int., not given, Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $24,531. Hydrant rental, $37.

Management.—Prest., G. A. Hobart. V. Prest. and Supt., Wm. Ryle. Treas., Jno. J. Brown.

PENNINGTON, *Mercer Co.* (Pop., est., 700.)

History.—Built in '86-8, and put in operation in '87, by Pennington Spring Water Co., under a perpetual franchise. No hydrants have been put in for fire protection. Engr. and Contr., D. A. Clarkson, Pennington.

Water Supply.—Spring, by gravity. Spring issues from base of mountain about 50 ft. above highest part of town, and 2½ miles distant, furnishing an abundant supply. The supply main is of 4-in. iron.

Reservoir.—Banks built of clay, oval, 110 by 75 ft., by 20 ft deep; cap., 600,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. Pipe furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 60, more being added. *Meters*, 1. *Valves*, Eddy.

Consumption, 20,000 galls. *Pressure*: 20 lbs.

Financial.—Cost, $9,000. Capital stock, $10,000. No debt. Ann. op. exp., very light. Ann. rev.: not given, but sufficient to pay 6 % dividend first year, above all expenses.

Management.—Prest. and Supt., D. A. Clarkson. Secy., Jno. J. Muirkheid.

PERTH AMBOY, *Middlesex Co.* (Pop., 4,808; est., 6,500.) At mouth of Raritan river, on Raritan bay, on level ground. Engaged in ship-building, and manufacturing fire brick and terra cotta.

History.—Built in '82 by private company, name not given.

Water Supply.—Springs and surface water, by pumping to stand-pipe from impounding reservoir.

Reservoir.—Cap., 20,000,000 galls.; in ravine, 1¼ miles from town.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; one noncondensing, used in case of fire, and one duplex condensing, Blake pumping engine, each having a dy. cap. of 1,500,000 galls.; Babcock & Wilcox boiler.

Stand Pipe.—Plate-iron, 20 ft. in diam. and 71 ft. high.

Distribution.—*Mains*, c. i., 6.7 miles. *Services*, w. i., lead. *Taps*, 238. *Meters*, 48. *Hydrants*, Chapman, Ludlow, 62. *Valves*, kind, do.

Consumption, 350,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. Capital stock, $100,000. Bonded debt, $66,000. Int., $66,000. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $31,000. Hydrant rental, $50.

Management.—Prest., Wm. Hall. Supt., Milton A. Brown.

PHILLIPSBURG, *Warren Co.* (Pop., 7,181; est., 8,500.) On Delaware river opposite Easton, Pa. Has manufactories.

History.—Built in '87 by The People's Water Co. Engr., J. Marshall Young, Contr., S. B. Mutchler & Bro., Phillipsburg. The Lehigh Water Co., of Easton, Pa., also supply a part of the town.

Water Supply.—Well, pumping to reservoir. It was proposed to take the supply from the Delaware river, but in digging the pump-well an ample supply of fine water was obtained.

Pumping Machinery.—Gordon & Maxwell pump, dy. cap., 2,000,000 galls.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 65. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure*: Ordinary, 165 lbs. Fire, 165 lbs.

Financial.—Cost, $100,000. No further data given.

Management.—Prest., Saml. Thomas. Treas., Jno. Bachman. Supt., Geo. G. Stryker.

PRINCETON, *Mercer Co.* (Pop., 3,209; est., 3,800.) On narrow ridge with nearly level crest. Settled early in the last century.

History.—Built in '83 by Princeton Water Co. Des. Engr., J. J. R. Croes, New York. Const. Engr., H. W. B. Phinney, West Fall Brook, Cal.

Water Supply.—Ground water, from well in valley to the east, by pumping to stand-pipe. The well is about 150 ft. below the village, is sunk through 6 ft. of alluvial deposit, and 10 ft. of saturated gravel, to sandstone, the well being 25 ft. in diam., bricked.

Pumping Machinery.—One Worthen and one Worthington pump, combined dy. cap., 1,000,000 galls.

Force Main.—Cast-iron, 10-in., 6,000 ft. long.

Stand Pipe.—Plate-iron, 20 ft. in diam., 60 ft. high, standing on an iron trestle 60 ft. high. Top is 90 ft. above highest ground in village, and 260 ft. above water in well.

The trestle rests on four stone piers, 10 ft. sq. at bottom, 5 ft. sq. at top, and 8 ft. deep, capped with a stone 4 ft. sq. and 18 in. thick, with two 1⅜-in. bolts running through and fastening the trestle to the foundation. The 10 in. force main is carried up near the center of the structure, has an expansion joint about 20 ft. above the ground, and is extended to within 15 ft. of the top to ensure circulation. When the pump is not working water is drawn off through a T branch in the pipe, near the bottom of the stand-pipe, furnished with a check valve opening into the pipe, which closes when the pump is in operation. On top of the structure is a meteorological observatory erected by Prof. W. Libbey, Jr., specially to obtain unobstructed wind observations. The stand-pipe was designed by Theo. Cooper, New York City, and built by Tippett & Wood, Phillipsburg.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Part of pipe and specials furnished by Warren Foundry and Machine Co., Phillipsburg. *Taps*, 240. *Meters*, 220. *Hydrants*, Eddy, 49. *Valves*, Eddy.

Consumption, 60,000 galls. *Pressure*: Ordinary, average, 40 lbs. Fire, average, 60 lbs.

Financial.—Cost, $53,000. Capital stock, $50,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $3,400. Ann. rev.: consumers, $5,500; city, $1,200.

Management.—Prest., Chas. E Green. Secy. and Treas., Prof. W. Libbey, Jr.

NOTE:—An illustration showing elevation and details of the stand-pipe, or tower, was given in *Eng. News*, vol X., p. 579.

RAHWAY, *Union Co.* (Pop., 6,455; est., 7,000.) On Rahway river, at head of tide, 19 miles from New York City. Has manufactories. Settled in 1720; incorp. a city in '58.

History.—Built in '71-2 by city. Engr., Geo. H. Bailey.

Water Supply.—Rahway river, direct pumping.

Pumping Machinery.—Combined dy. cap., 3,000,000 galls.; two Worthington pumps, dy. cap. of each, 1,500,000 galls.

Distribution.—*Mains*, w. i. and cement, 13 miles. *Services*, lead, iron. *Taps*, 643. *Meters*, none. *Hydrants*, Mathews, 125. *Valves*, Whittier Machine Co.'s. *Pressure Gauge*, Edson.

Consumption, 800,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 70 to 75 lbs.

Financial.—Cost, $185,000. Bonded debt, $185,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers and city, $10,600.

Management.—Five Commrs. Prest., Ira Laforge. Supt., A. B. Bunn.

RARITAN, *Somerset Co.* (Pop., 2,046; est., 6,000.)

History.—Built in '82 by Somerville Water Co., of Somerville, which see.

RED BANK, *Monmouth Co.* (Pop., 2,684; est., 5,000.) On Shrewsbury river, at head of navigation, 26 miles from New York City. Has canneries and carriage manufactories.

History.—Finished in spring of '85 by village. Engr., Chas. G. Darrach, of Wilson Bros., Civil Engineers, Philadelphia, Pa. Contrs., Wm. Richardson and Wm. Farrar, both of Red Bank.

Water Supply.—Well, pumping to reservoir, and direct pumping. Well is 15 ft. in diam. and 66 ft. deep, and is lined with brick laid in Portland cement. The cap. of the well 54 ft. below the surface is from 250,000 to 275,000 galls.

Pumping Machinery.—Combined dy. cap., 1,200,000 galls.; two special vertical compound duplex Worthington pumps. The intermediate iron trestle between the steam cradles and the pumps, including the long piston rods, were built and erected by the Wharton R. R. Switch Co. This trestle is 41⅝ ft. long.

Reservoir.—Cap., 800,000 galls.; is 169 ft. above bottom of well, 140 ft. above tide-level, and 120 ft. above main level of town.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 160. *Meters*, 47. *Hydrants*, kind not given, 49.

Consumption, 125,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 55 lbs.

Financial.—Cost, $60,000. Debt, $60,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers, (In '85,) $3,500.

Management.—Commrs. Address Anthony Reckless.

NOTE:—An illustrated description of well and pumping machinery was given in *Eng. News*, vol. XIV., pp. 130-1.

SALEM, *Salem Co.* (Pop., 5,056; est., 6,000.) On Salem river, 2½ miles from mouth of the Delaware, on flat, sandy ground. Has glass manufactories, and fruit and vegetable packing establishments. Settled in 1675; incorp. a city in '58.

History.—Built in '82 by city. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Well and surface water, by direct pumping from impounding reservoir on Laurel river. The stream has a drainage area of 5 sq. m.

Reservoir and Dam.—Cap., 42,000,000 galls.; dam is of earth, founded on solid rock, 12 ft. below natural surface, is 280 ft. long, 15 ft. wide on top, has inner slope 3 to 1, outer 2 to 1. Waste water is carried under the bank by a 6-ft. conduit.

The conduit to pump well is of 12-in. cast-iron, 4 miles long.

Pumping Machinery.—Holly pump, dy. cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 8.4 miles. *Services*, galv. i. *Taps*, 325. *Meters*, none. *Hydrants*, Cassin, 59. *Valves*, Cassin.

Consumption, 250,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 110 lbs.

Financial.—Cost, $80,000. Debt, $75,000. Int., 5%. Ann. op. exp., including construction, $4,744. Ann. rev.: consumers, 4,000; city, $6,350.

Management.—Supt., Chas. W. Casper.

SEABRIGHT, *Monmouth Co.* (Pop., est., 1,000 in winter and 3,000 in summer.) On Atlantic Ocean 5 miles from Long Branch, and 26 from New York City. Summer resort, and has fishing interests.

History.—Built for domestic supply in '87 by Seabright Water Supply Co., under the direction of C. H. Dederer, there being no general contractor.

Water Supply.—Nine artesian wells, pumping to stand-pipe. Six of the wells were 150, and the rest, 250 ft. deep. Six were put down by Kissner & Bennett, Ocean Grove.

Pumping Machinery.—Hall, dy. cap., 1,000 000 galls.

Stand-Pipe.—Made by Cunningham Iron Works, Boston; 12 ft. in diam. by 80 ft. high.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i. *Taps*, 30. *Meters*, none.

Consumption and Pressure, not given.

Financial.—Cost, $19,000. Capital stock, $25,000. No debt. No further data given.

Management.—Prest., J. R. Minugh. Secy., Geo. Elliott. Treas. and Supt. Mifflin Paul.

SHORT HILLS, *Essex Co.* (Pop., est., 400.)

History.—Built in '80 by Stewart Crosscup.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., 45,000 galls.

Reservoir.—Cap., 4,000,060 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, c. i., w. i. *Taps*, 50. *Meters*, Crown, number not given. *Hydrants*, 2.

Consumption, 30,000 galls. *Pressure*: not given.

Financial.—Cost, $70,000. Debt, not given, none in '86. Ann. op. exp., $1,600. Ann. rev.: consumers, $800; city, not given. Hydrant rental, not given.

Management.—Owned by Stewart Hartshorn. Supt., Geo. E. Crosscup.

SOMERVILLE, *Somerset Co.* (Pop., 3,105; est., 6,000.) On Raritan river. Settled about 1,800.

History.—Built in '82 by Somerville Water Co., the system including Raritan. Engr., Geo. H. Pierson.

Water Supply.—Raritan river, filtered, by pumping to stand-pipe, and by direct pumping. The river flows through a red shale district, and the water before filtering is much discolored, except in very dry weather, and contains sediment.

Filters.—Four Hyatt, multifold, 5 ft. in diam., 8 ft. high. Cap., 500,000 galls.

Pumping Machinery.—Two Worthington pumps, dy. cap., 500,000 galls. each.: one driven by a 44-in. Leffel turbine, under 14 ft. head; the other being a steam pump.

Stand-Pipe.—Is 10 ft. in diam., and 150 ft. high.

Distribution.—*Mains*, c. i., 7 miles; furnished by Warren Foundry & Machine Co. Phillipsburg. *Services*, lead. *Taps*, 400. *Meters*, 6. *Hydrants*, Eddy, 39. *Valves*, Eddy. *Filter*, Hyatt. cap., 275,000 galls.

Consumption, 375,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 60 lbs.

Financial.—Cost, $62,000. Capital stock, $50,000. Debt, $2,000. Int., 5 %. Ann. op. exp., $3,000. Ann. rev.: consumers, $6,300; cities, $5,910.

Management.—Prest., Adolph Mack. Secy., A. V. D. Honeyman. Treas., Hugh K. Gaston. Supt., J. Harper Smith.

TRENTON, *Mercer Co.* (Pop., 29,910; est., 40,000. Est. pop. supplied, 55,000.) On Delaware river, at head of steam navigation, on undulating ground rising in some places 100 ft. above river. The Assanpink creek flows through the city. Manufactures and decorates pottery, also makes wire and wire-rope, rubber goods, and has large rolling mill. Settled in 1700.

History.—Built for domestic supply by company in '83; purchased and rebuilt for general supply by city in '55. System includes supply for Milham and Chambersburg.

The supply in '03 was furnished by a company organized that year by Stephen Scales and chartered with a capital stock of $1,200. The supply was from a spring and was continued until '52 when the company was authorized to pump water from the Delaware river, and build reservoirs. A 10-in. water-power pump was erected and a 1,415,000-gall. reservoir built 100 ft. above the river. The company had expended $88,000 on the works in '55 when the city bought most of the stock, and introduced fire hydrants. In '56 an additional reservoir was built. Engr., Chas. Potts. In '63 a steam pumping engine of 12-in. bore was built by Wm. Carr.

Water Supply.—Delaware river, pumping to reservoir.

Pumping Machinery.—Combined dy. cap., 10,000,000 galls.; a 6,000,000 and a 2,000,000-gall. Worthington, and a 2,000,000 Wright pumping engine.

Reservoirs.—Cap., 20,000,000 galls. There is also a "basin," but no description of it is given.

Distribution.—*Mains*, c. i., 40 miles. *Services*, galv. i. *Taps*, 8,102. *Meters*, 46. *Hydrants*, Detroit, 242.

Consumption, 2,256,000 galls. *Pressure*: Ordinary, 30 lbs.

Financial.—Cost, $445,946. Debt, $265,000. Int., 5 % on $5,000; on the remainder, 6 %. Ann. op. exp., $14,947. Ann. rev.: consumers, $74,375; from Milham and Chambersburg, $408 for hydrants.

Management.—Commrs. Prest., Robt. Ailkin. Secy. and Treas., Jno. J. Sager. Supt., Thos. E. Boyd.

UNION, *Union Co.* (Pop., 2,418.)

History.—Since '83 from Hoboken since '83 by Hackensack Water Co., Roorganized, which see.

VINELAND, *Cumberland Co.* (Pop., 2,519; est., 3,250.) In Landis township.

History.—Built in '86 by Chas. J. Leighley, after plans by himself.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Holly-Gaskill pump, dy. cap., 200,000 galls.

Tank.—Is 30 by 15 ft.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 36.

Consumption, 175,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 45 lbs.

Financial.—Cost, $40,000. Debt, none. Ann. op. exp., small, being run in connection with owner's factory. Ann. rev.: not given. Hydrant rental, $30.

Management.—By owner, Chas. J. Leighley.

WASHINGTON, *Warren Co.* (Pop., 2,142; est., 3,000.) Manufactures pianos, cabinet organ and shoes.

History.—Built in '82 by Washington Water Co. No general contractor.

Water Supply.—From small stream, by gravity. There is a reservoir.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, iron. *Taps*, 150. *Meters*, not given. *Fire plugs*, 40.

Consumption, not given. *Pressure*, Ordinary, 85 lbs.

Financial.—Cost, $35,000. Capital stock, $35,000. No debt. No further financial data given.

Management.—Prest., Z. W. Fitts. Treas., P. H. Hann. Supt., Danl. Vliet.

WEEHAWKEN, *Hudson Co.* (Pop., 1,102.)

History.—Supplied in '83 from Hoboken by Hackensack Water Co., Reorganized, which see.

WEST HOBOKEN, *Hudson Co.* (Pop., 5,441.)

History.—Supplied in '83 from Hoboken by Hackensack Water Co., Reorganized, which see.

WOODBURY, *Gloucester Co.* (Pop., 2,302; est., 4,200.) On Woodbury creek, 7 miles from Camden and 3 from Delaware river.

History.—Built in '86 by village. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—Head of Mantua creek, pumping from settling to distributing reservoir. Direct pumping can be used in case of fire.

Pumping Machinery.—Gordon & Maxwell pump, dy. cap., 1,000,000 galls.

Distributing Reservoir.—Cap., about 1,000,000 galls.; is 100 ft. sq. and 14 ft. deep.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 353. *Meters*, 2. *Hydrants*, kind not given, 59.

Consumption, 100,000 galls. *Pressure*: Ordinary, 38 to 60 lbs. Fire, do.

Financial.—Cost, $70,000. Bonded debt, $72,000. Int., 4%. Ann. op. exp., $1,400. Ann. rev.: consumers, $4,000: city, none.

Management.—Chairman Water Comm., J. G. Cloud. Supt., F. C. White.

Water-Works Projected with Fair Prospects of Construction.

FREEHOLD, *Monmouth Co.* (Pop., 2,432; est., 3,000.) Has some manufactories and considerable trade.

Proposed System.—Artesian wells, pumping to stand-pipe, probably. Est. cost, $30,000 to $40,000. An attempt has been made to induce the town to build works, but nothing has yet been done.

Present Supply.—Wells, and 14 cisterns supplied from roofs of buildings.

TOM'S RIVER, *Ocean Co.* (Pop., est., 1,500.) At head of Tom's river bay. Engaged in coasting trade and cranberry culture.

Proposed System.—Projected in '87, but matters not sufficiently advanced in June '88 to give definite information. It is unofficially stated that the water will be pumped to stand-pipe, that there will be 7 miles of pipe, and that Island Heights will also be supplied. For information address Jno. P. Haines.

Water-Works Projects Reported in '87-8, but now Indefinite.

Plainfield, *Union Co.*; West Orange, *Essex Co.*

DELAWARE.

Water-Works Completed or in Process of Construction.

DOVER, *Kent Co.* (Pop., 2,811; est., 4,500.) On Jones creek, 5 miles from Delaware bay, on level ground. Has a large glass factory, and is in a peach growing and agricultural district. Settled in 1683.

History.—Built in '82 by town. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Wells, by direct pumping. One well is 15 ft. in diam. by 24 ft. deep; the other, 20 ft. in diam. by 28 ft. deep. The first well was sunk for 17 ft. through water-bearing strata.

Pumping Machinery.—Two Holly-Gaskill duplex low-pressure pumps, combined dy. cap., 1,000,000 galls.; two 60 H. P. horizontal tubular boilers.

Distribution.—*Mains*, c. i., 3¾ miles. *Services*, galv. i., lead. *Taps*, 240. *Meters*, 7. *Hydrants*, Holly, 29.

Consumption, 80,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, $23,000. Bonded debt, $21,500. Int., 4%. Ann. op. exp., $2,400. Ann. rev.: consumers, $3,200; city, none.

Management.—Water Commr. of three from the Council. Chf. Engr., T. F. Cook.

NEW CASTLE, *New Castle Co.* (Pop., 3,700; est., 4,000.) On flat sandy ground on Delaware river at head of Delaware bay, 5 miles from Wilmington. Has iron and pipe works, cotton, woolen, carpet and rolling mills. Settled in 1600; incorp. a city in '73.

History.—Built in '70 by New Castle Water-Works Co. Engr., Isaac S. Cassin, Philadelphia, Pa.

Water Supply.—None Such creek, which is fed by springs, pumping to reservoir.

Pumping Machinery.—Combined dy. cap., 2,500,000 galls.; one 750,000-gall. Blake, and one 1,750,000-gall. Davidson, pump.

Reservoir.—Cap., 1,250,000 galls.; is 92 ft. above city.

Distribution.—*Mains*, c. i., 8.5 miles. *Services*, iron. *Taps*, 507. *Meters*, none. *Hydrants*, 40 furnished by Morris, Tasker & Co., Philadelphia.

Consumption, 450,000 galls. *Pressure*: Ordinary, 26 lbs. Fire, 26 lbs.

Financial.—Cost, $112,000. Capital stock, $51,000. Bonded debt, $54,000. Int., 5%. Ann. op. exp., $4,500. Ann. rev.: consumers, $8,000; city, none.

Management.—Prest., Jas. G. Shaw. Secy. and Treas., Wm. H. Clark. Engr-in-Charge, I. C. Slaw.

SMYRNA, *Kent Co.* (Pop., 2,423; est., 3,000.) In Duck Creek hundred. Engaged in manufacturing, and peach trade.

History.—Built in '86 by town. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs. A. H. Coon & Co.

Water Supply.—Open well, pumping to stand-pipe, and direct pumping.

Pumping Machinery.—Combined dy. cap., 750,000 galls.; two Gordon & Maxwell compound duplex pumps.

Stand-Pipe.—Is 8 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 240. *Meters*, none. *Hydrants*, kind not given, 31.

Consumption, 50,000 galls. *Pressure*: Ordinary, 52 lbs. Fire, 100 lbs.

Financial.—Cost, $24,000. Debt, $24,000. Int., 4%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,800; city, $620.

Management.—Board Town Commrs. Secy., J. B. Cooper. Supt., A. Taylor

WILMINGTON, *New Castle Co.* (Pop., 42,478.) At confluence of Brandywine and Christiana creeks, at head of navigation, and 2 miles from Delaware river. City is on elevated ground between the two creeks, rising from them on three sides, and reaching an elevation of 243 ft. at the north. Build wooden and iron steamboats, and cars, manufactures cotton and woolen goods, morocco and powder. The first Swedish colony in America landed here in 1638, and in 1698 a Swedish church was built, which was standing in '81. The town was founded in 1732; incorp. a borough in 1740, a city in '32.

History.—First supplied in '04 by Wilmington Spring Water Co., whose works were bought by the borough in '10, and extended from time to time since, the most important changes being in '64 and '74.

The first supply was from a "fountain" in High, now Fourth street, which was fed by springs, and furnished water to the part of the town lying below. The price paid in '10 by the borough for these works was $10,000, and water was conveyed from springs through wooden pipes along the principal streets to cisterns, from which it was drawn by pumps. The supply gradually decreased from 35 galls. a minute in '10 to 14, in '20, and in '25 a 3-in. iron pipe having been laid to a reservoir between the present 10th and 11th streets, a contract was made for iron pipe to conduct water from this reservoir down Market to 4th street, and for fire plugs along the line.

In '27 a water-power was purchased on Brandywine creek, and an overshot wheel put in, 14.5 ft. in diam. by 45.25 ft. wide, which worked a double-acting force pump of 8-in. bore and 72-in. stroke. Water was lifted to two reservoirs, 99 ft. above, through 2,120 ft. of 8-in. pipe. The reservoirs were abandoned in '79. In '32 a similar pump was added. In '79 the wheel went to pieces, and the pumping machinery was replaced in '81 by a Jonval turbine, working two 1,600,000-galls. pump. The water-power pumps were abandoned in '87, as worthless. In '55 a 3,000,000-gall. Cornish bull engine was erected for use in case of emergency. It was not used after '77, and has been removed. In '64 a high service supply was introduced and since then the works have been extended to the system described below, which was completed in '87, the large reservoir being built from '74-8. Engr. of reservoirs, Isaac S. Cassin, Philadelphia, Pa. The water department was organized in '27.

Water Supply.—Brandywine creek, pumping to low service reservoir, and re-pumping to high service reservoir. The creek falls 120 ft. in 4 miles above the city.

Pumping Machinery.—*Main works*: combined dy. cap., 15,000,600 galls.; one 10,000,000-gall. compound condensing Corliss, and one 5,000,000 gall. compound duplex Worthington pumping engine. The latter placed in '72, the former in '87; *High service*: combined dy. cap., 3,500,000 galls.; one 2,000,000-gall. Knowles pump, placed in '80 and one 1,500,000-gall. Worthington pump.

Reservoirs.-The principal one has a cap. of 40,000,000 galls., and the high service, of 1,600,000 galls. The latter is 210 ft. above the creek, and about 106 ft above the pumping station supplying it; it is in excavation and embankment, the inner slopes being lined with clay puddle and paved with brick laid in cement. The main distributing, or Coal spring, reservoir was estimated to cost $86,000, for a basin 18 ft. deep, holding 28,000,000 galls. It was begun in '74, by day labor, and in Nov., '76 over $129,000 had been expended, and it was estimated that $90,000 was required to finish it. Trouble arose from spring water passing through the bank into the reservoir, the drain intending to carry it off becoming stopped, and water passing along the inlet and outlet pipes laid through the banks. The drains were of 2, 3 and 4-in. pipe, some with lead and some with open joints, and the inlet and outlet pipes had not been properly laid.

In '77 a special water commission was created by the Legislature to complete the reservoir. The adjoining land was walled up to divert surface water from the banks, the bottom and sides were puddled with 2 ft. of clay, and the slopes lined with two courses of brick laid in cement. The bottom puddle was covered with gravel rolled in, then paved with bricks laid flat in sand, and collars of masonry were placed around the inlet and outlet pipes. The 11,000,000-gall. basin was finished in Dec., '77, and the other in Oct., '78. As stated above, the present cap. of the reservoir is 40,000,000 galls. Water is pumped to the north basin, and passes over the division wall to the south. In Nov., '78, just after the new basin was filled, an increase was noticed in the flow of the under drains, and a small hole discovered in the bottom of the north basin. It was stopped up and no further trouble was had until Mar., '80, when the slope pavement on the east side of the south basin partially slid down for about 100 ft. in length. It was repaired by first building at the foot of the slope a brick wall 33 in. wide at top and 39 at bottom, and then re-puddling and repaving the break. The north and west slopes were strengthened by a similar wall at their base.

Distribution.—*Mains*, c. i., 69.5 miles. *Services*, w. i., lead. *Taps*, 10,869. *Meters*, 7. *Hydrants*, generally Chapman, 625. *Valves*, kind, do.

Consumption, 5,272,334 galls. *Pressure*: Ordinary, 15 to 50 lbs. Fire, do.

Financial.—Cost, $760,000. Bonded debt, $632,000. Int., 3½, 4½, 5 and 6%. Ann. op. exp., about $50,000. Ann. rev.: consumers, $104,536; city, none.

Management.—Three Commrs. Prest., Wm. T. Porter. Chf. Engr., Jos. A Bond. Registrar, John S. Grohe. Inspector and Collector, Geo. H. P. Simmons.

PENNSYLVANIA.

Water-Works Completed or in Process of Construction.

ALLEGHENY, *Allegheny Co.* (Pop., 46,682; est., 80,000.)] At junction o Allegheny and Ohio rivers, opposite Pittsburgh, with which it is connected by bridges. Near the rivers the ground is quite level, but at ½ to 1½ miles back it rises abruptly to from 500 to 600 ft. above the rivers. The hillsides are cut by 5 or 6 ravines through which flow small streams.

History.—Built in '47 by city when population was about 18,000. Des. Engr., R. Moore.

Water Supply.—Allegheny river, pumping to reservoir. Water is taken from the river 1½ miles above its mouth through two cast-iron pipes extending 500 ft. from shore into channel.

Pumping Machinery.-Combined dy. cap.,20,000,000 galls. Water was first pumped by two lever engines, coupled together, with 22-in. steam cylinders, and 12 in. pumps, all of 96-in. stroke, the cap. being 1,500,000 galls. In '54 these pumping engines were duplicated. In '74 a Lowry pumping engine was added, having 44-in. horizontal cylinders with 168-in. stroke, and two vertical 36-in. plunger pumps with 132-in. stroke. An Allis pump has since been added. Natural gas is used for fuel.

Reservoir.—Cap., as first built, 9,600,000 galls.; is 217 ft. above, and 600 ft. from pumps, with a water surface of 1.5 acres. In excavation and embankment, the bottom covered with 18 in. of puddle, on which a 2-in. brick pavement is laid in sand; slopes are lined with 24 in. and paved with 4 in. of brick laid in cement. The reservoir is divided in two parts by a wall of stone masonry, having a footing of concrete on puddle. It is said that there is now a reservoir cap. of 18,000,000 galls., and a new reservoir has been projected.

Distribution.—*Mains*, c. i., 70 miles. *Services*, lead. Pipe and special furnished by National Foundry & Pipe Works, Scottdale. *Taps*, (in '84,) 12,937. *Meters*, not given. *Hydrants*, 900, furnished by J. R. Hutchinson.

Consumption, 17,823,500. *Pressure*: 15 to 130 lbs.

Financial.—Cost, $1,636,460. Bonded debt, $909,000. Int., 4 to 7%. Sinking fund, $120,171. Ann. op. exp., $90,000. Ann. rev.: consumers, $154,821.

Management.—A Comm. consisting of 7 from the Select and 9 from the Common Council. Prest., Thos. Brown. Supt., Edward Armstrong.

NOTE:—Surveys and estimates were made in '87 for a new water supply, and the most desirable source was found to be the Allegheny river, at or near Nine Mile Island, about nine miles from the city. Two plans have been proposed, the first contemplating the construction of two connected reservoirs with a cap. of over 100,000,000 galls., and the other pumping through mains to the wells of the present pumping station. The estimated cost of the first plan, including steel tubing for the delivery main, is $2,309,742, and for the second, $731,418. The second plan includes cribs, well and pump-house at Island, three 10,000,000-gall. duplex horizontal compound condensing pumping engines, 43,824 ft. of 60-in. riveted steel-tube 5-16 in. thick, and 30 manholes. The two plans are given in detail in the annual reports of the City for '87.

ALLENTOWN, *Lehigh Co.* (Pop., 18,063; est., 25,000.) On high ground on west bank of Lehigh river, between the Little Lehigh on the north and Jordan creek on the south. The streets leading up from the rivers are all steep. Manufactures iron, wire, thread, silk, hosiery, shirts, shoes and furniture. Settled in 1762; incorp. a borough in '11, a city in '67.

History.—Works are now owned by city; built in '27 by Northampton Water Co., which was incorp. in '16, and reorganized some years later as Allentown Water Co., and purchased by borough in '65. In '33 the property of the Co. was valued at $18,000, and it was sold in '65 for $140,000.

Water Supply.—Springs, pumping to reservoir and stand-pipe. Originally water was brought from the springs through 2,300 ft. of 12-in. pipe to the pump-well and lifted thence by water-power pumps: a timber dam across the Lehigh river, 6 ft. high, furnished the power. New pumps were added in '88.

Pumping Machinery.—Two Knowles pumps, combined dy. cap., 6,000,000 galls.

Reservoirs.—Cap., 410,242 galls.; two, covered, one being 28.8 by 47.8 ft. by 13 ft. deep, the other 32 by 95.6 ft., by 12 ft. deep.

Stand-Pipe.—Is 7 ft. in diam. by 76 ft. high; made by Tippett & Wood, Phillipsburg, N. J., and erected in '88.

Distribution.—*Mains*, c. i., 27 miles. *Services*, c. i. *Taps*, 3,300. *Meters*, one. *Hydrants*, Cassin, Mathews, Tamaqua, 167.

Consumption, about 2,000,000 galls. *Pressure*: Ordinary, 90 lbs.

Financial.—Cost, $278,482. Bonded debt, $110,200. Int., 4, 5, and 7%. Ann. op. exp., $8,065. Ann. rev.: total, $27,000.

Management.—Four Commrs. Prest., S. S. Frederick. Supt., Saml. S. Thompson.

ALTOONA, *Blair Co.* (Pop., 19,710; est., 30,000.) Is 1,600 ft. above the sea, in a long valley, the longitudinal streets being nearly level, and the cross streets rising steeply. Has railroad shops and several manufactories. Incorp. a city in '68.

History.—Built in '71 by city when population was about 11,000. Des. Engr., H. P. M. Birkinbine, Philadelphia. Const. Engr., F. E. Lythe. Later extensions, including the large storage reservoir, were made with Chas. W. Knight, Rome, N. Y., Des. Engr., and J. W. Ladoo, Engr.-in-charge.

Water Supply.—Surface water, by gravity from impounding and distributing reservoirs.

Reservoirs.—*Impounding*: Cap., 60,000,000 galls.: formed by dam across stream. *Distributing*: Cap., 3,000,000 galls. The first reservoirs consisted of a small impounding, 6 miles from city, and 278 ft. above main street, and a distributing reservoir, 200 ft. sq., and 20 ft. deep, on a hill south of city, and 150 ft. above main street.

Distribution.—*Mains*, c. i., 35.8 miles. *Services*, galv. i. *Taps*, 5,272. *Meters*, none. *Hydrants*, Mathews, 112. *Valves*, Eddy, W. S. Payne.

Consumption, 175,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $359,000. Bonded debt, about $250,000, Int., 4%. Ann. op.exp., $16,000. Ann. rev.: consumers, $36,560; city, $7,054.

Management.—Three Commrs. Supt., S. A. Gailey.

ARCHBALD, *Lackawanna Co.* (Pop., 3,049; est., 3,500.) On Laurel run, a mountain stream.

History.—Built in '75 by Archbald Water Co. Engr., O. L. Shepherd. Contrs., Curlin & Palmer, Scranton.

Water Supply.—Laurel run, by gravity from impounding reservoir.

Reservoir and Dam.—Are 250 ft. above and 2,000 ft. from town, the dam being of timber. Water was first conveyed from reservoir to town through 10-in. stoneware pipe, which gave way in a few years; in '83 1,500 ft. of it was replaced by cast-iron pipe.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. Pipe and specials furnished by Leonard Bros., Scranton. *Taps*, 200. *Meters*, none. *Hydrants*, 6; furnished by Bishop Bros.

Consumption, unknown. *Pressure*, Ordinary, 90 lbs. Fire, 90 to 100.

Financial.—Cost, $20,000. In '84 there was a debt of $1,500 at 5% int. It is not stated whether this has been paid, but there is no bonded debt. Ann. op. exp., $500. Ann. rev.: consumers, $2,600; city, none, there being no hydrant rental.

Management.—Prest., J. J. Williams. Secy., Thos. Law. Treas., Jno. Carrol. Supt., Justus Bishop.

ASHLAND, *Schuylkill Co.* (Pop., 6,052; est., 7,300.) On Mahanoy creek, in mountainous country. A mining and manufacturing town. Settled in '48; incorp. a borough in '57.

History.—Built in '76 by borough. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Little Mahanoy creek, by gravity. The stream has its source in Broad mountain, 1,400 ft. above the sea.

Reservoirs.—Two, cap., 2,000,000 and 1,800,000 galls., respectively.

Dam and Conduit.—The first reservoir built was formed by a dam across the stream, of stone, backed with clay. It was 5 miles from, and 345 ft. above the town, with which the reservoir was connected by 27,400 ft. of 12-in. cast-iron pipe.

Distribution.—*Mains*, c. i., 9.8 miles. *Services*, w. i., lead. *Taps*, 764. *Meters*, none. *Hydrants*, Cassin, 36. *Valves*, Cassin.

Consumption, 350,000 galls. *Pressure*: Ordinary, 120 lbs. Fire, 120 lbs.

Financial.—Cost, $85,000. Bonded debt, $49,000. Int., 4 and 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $8,200; city, none.

Management.—Three Commrs. Chairman, Jas. R. Dugan. Secy., Frank Rentz. Supt., Jos. Hardenock.

ASHLEY, *Luzerne Co.* (Pop., 2,799.)

History.—Supplied by Crystal Spring Water Co., of Wilkes Barre. No official returns can be obtained for '88, but previously there were 3 miles of pipes and 16 hydrants, the fire pressure being 110 lbs. Address the Company, or T. H. Phillips, at Wilkes Barre.

ATHENS, *Bradford Co.* (Pop., 1,599; est., 3,000.) About a mile from Sayre, on a plain between the Chemung and Susquehanna rivers, a short distance above their junction. Has large iron bridge works. Settled in 1790.

History.—Built in '84 by Sayre Water Co., which see.

BEAVER, *Beaver Co.* (Pop., 1,178; est., 1,600.) On the Ohio, near mouth of Beaver river, which furnishes waterpower used in manufacturing.

History.—Built in '86 by village. Des. Engr., Jacob Schreuneller, Pittsburgh. Const. Engr., W. S. Watson, Beaver.

Water Supply.—Ohio river, (filtered,) pumping to reservoir.

Pumping Machinery.—Worthington and Blake duplex pumps, combined dy. cap., 100,000 galls.

Reservoir.—Cap., about 300,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 70.

Consumption, about 300,000 galls. *Pressure*: Not given.

Financial.—Cost, $20,000. Debt, $6,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: none.

Management.—Secy. of Council, E. N. Biggett. Supt., Geo. Joyce.

BEAVER FALLS, *Beaver Co.* (Pop., 5,104; est., 10,000.) On Beaver river, 4 miles from its junction with the Ohio, and 31 from Pittsburgh. Manufactures glassware, and all kinds of hardware.

History.—Built in '75 by Beaver Falls Water Co., when population was about 3,000. Des. Engrs., Jno. Reeves and H. Rice. Const. Engr., J. W. Ramsey.

Water Supply.—Beaver river, filtered through bank to well, thence by direct pumping and pumping to reservoir.

Pumping Machinery.—Wilson & Snyder pumps, dy. cap., 4,000,000 galls. The first pumps were of the Holly pattern, driven by water-power.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 1,421. *Meters*, 1. *Hydrants*, made by Ramsey & Corbus, 86 public and 25 private. *Valves*, Ludlow.

Consumption, 2,500,000 galls. *Pressure*: Ordinary, 73 lbs. Fire, 110 lbs.

Financial.—Cost, $175,000. Capital stock, $160,000. No debt. Ann. op. exp., $6,000 Ann. rev.: consumers, $13,000; city, $2,150.

Management.—Prest., H. T. Reeves. Supt., Jno. W. Ramsey.

BEDFORD, *Bedford Co.* (Pop., 2,011; est., 3,000.) On Raystown branch of Juniata river, on high ground between two ridges, one of which rises about 1,200 ft. above the valley. Deposits of hematite and limestone close by.

History.—Built in '72-6 by town under direction of a water commission, there being no Engr. or Contr.

Water Supply.—Mountain springs, by gravity.

Reservoirs.—Three, the largest having cap. of 600,000 galls., the others much smaller. They are in excavation and embankment, the first two built having a flow line 120 ft above town, and being puddled with clay, lined with brick on edge laid dry.

Distribution.—*Mains*, c. i., about 8 miles. No other data given.

Financial.—Cost, $35,000. Bonded debt, $23,500. Int. 6%., Ann. op. exp., $500. Ann. rev.: derived indirectly from taxation, for '88, $2,900.

Management.—Commrs. Report made by Thos. Armstrong.

BELLEFONTE, *Centre Co.* (Pop., 3,026; est., 4,300.) In Spring township and on Spring creek, in very hilly limestone region. Manufactures lime, iron nails and window glass. Settled in 1795; incorp. a borough in '06.

History.—Built in '07 by borough.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Knowles pump, dy. cap., 1,440,000 galls. The first pumps were driven by water-power, and were of the single-acting plunger type.

Reservoir.—Cap., 290,000 galls.; is 196 ft. above pumps.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i., galv. i., lead. *Taps*, number said to be unknown. *Meters*, none. *Hydrants*, made by W. P. Duncan & Co., Bellefonte, 40. *Valves*, kind, do.

Consumption, 300,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $100,000. Debt, $118,955. Int., 5, 6 and 7%. Ann. op. exp., about $4,000. Ann. rev.: consumers, $7,000; city, none.

Management.—Supt., Saml. D. Ryan.

BETHLEHEM, *Northampton Co.* (Pop., 5,193; est., 6,000.) On northeast fork of Lehigh river and Monocacy creek, on high and uneven land. Engaged in manufacturing, and is in center of coal and iron region

History.—Settled in 1741; incorp. a borough in 1845. Believed to be the second water-works system for public supply built in the United States, the first works having been built in Boston in 1752. The Bethlehem works were begun in 1754, by Hans Cristopher Christiansen, a mill-wright and a native of Denmark, and "after severe struggles" were finished in 1761. Water was taken from a spring issuing from magnesian limestone, near the banks of the Menagassi creek, as it was then called It was conducted 350 ft. through an underground conduit to a cistern, or well, whence it was raised by a 5-in. lignum vitæ pump, through bored hemlock logs, to a wooden tank in the village square, 70 ft. above the pump. There being trouble from the bursting of the wooden pipes, 1¼-in. pipes of sheet lead were tried. They were soldered along the edges and bedded in a cement of pitch and brick dust, and laid in a gutter of brick. This expedient did not prove very successful.

In 1761, Christiansen, aided by John Arbo and Marshall, built larger works. An 18-in. under-shot wheel 2 ft. clear in the buckets, was put in, driving three single-acting iron force pumps of 4-in. bore and 18-in. stroke. The pumps were made by a blacksmith and cost £8 12s. and 4d. The records show that for his services, Christiansen received 30 shillings "for ye water running." The force main was of gum wood, and the distributing pipes of pitch pine. The latter had to be renewed in 1769, and in 1786 lead pipes were substituted for the gum wood force main, and also for most of the distributing pipes, and cisterns were built at various points of the village. Ever since this time a complete water works system has been maintained. The last pitch pine pipes were abandoned in 1791.

The wooden tank in the "little square" was removed in 1803 and a stone tower built in Market street, about 15 ft. high, on which was a tank at an elevation of 112 ft. above the spring. In '13 iron pipes were introduced having their joints packed with leather and clamped with iron. In '17 a reservoir, 70 by 10 ft., by 7 ft. deep, was built to meet the demands for an increased supply of water, and in '32 this was supplemented by a second reservoir. In the later year the triple pumps, having been in service for 70 years, were replaced by a double-acting pump of greater capacity with 5-in. bore and 3-ft. stroke, constructed by Rush & Muhlenberg of Philadelphia. This pump is still in use. In '45 the works came under the control of the Bethlehem Water Co. In '68 steam was substituted for water-power, and in '71 the works were purchased by the borough, from the Bethlehem Water Co., for $20,300. In '72 a tank was erected to regulate the pressure from direct pumping and in '74 the wooden conduit from the spring to the pump-well was replaced by an 18-in. cast-iron pipe and a Cameron steam pumping engine put in. In '85 a Worthington pump was added, and the latter part of '88 the borough is considering a proposition to improve the pumping facilities by putting in new boilers, a 2,000,000-gall. pump, and building a new pump-house.

It is interesting to know that early in their history these works filled those who saw them with astonishment and admiration, and on a register kept at that time are the names of many visitors of note, among whom were; in April 1768, Gov. Penn and Lady and Lord Chas. Montague; in 1774, Baron von Reefsdorf; in 1777, John Adams; in July, 1782, Gen. Geo. Washington, with his adjutants.

Water Supply.—Spring, direct pumping, with tanks as a regulator of pressure.

Pumping Machinery.—For early pumps, see History. The present pumps are a direct-acting 700,000-gall. Cameron, and a compound 500,000 gall. Worthington.

Tanks.—One 24 by 40 ft., and and one 10 by 66 ft.: made by McKee and Wilson, Bethlehem.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 772. *Meters*, none. *Hydrants*, Mathews, Tamaqua, 72. *Valves*, Ross.

Consumption, 650,000 galls. *Pressure*: Ordinary, 72 lbs. Fire, 72 lbs.

Financial.—Cost, about $75,000. Debt cannot be separated from tne general debt of borough. Int., 4%. Ann. op. exp., $4,800. Ann. rev.: consumers, $8,400; city, none.

Management.—Water Commrs. Chairman L. F. Giering. Supt., Chas. Bodder.

BERWICK, *Columbia Co.* (Pop., 2,095; est., 4,000.) In Briar township, on North branch of Susquehanna river. Manufactures cars, car-wheels and merchant iron. Settled in 1782; incorp. a borough in 1800.

History.—Built in '48 by Berwick Water Co.

Water Supply.—Spring on the river's bank, pumping to reservoir.

Pumping Machinery.—Dy. cap., 240,000 galls.; made by Cruikshank, Mayer & Co., Danville. In '82 a water-power pump was used in summer, and a steam engine in winter.

Reservoir.—Is 102 ft. above pump, small, of stone masonry, having on its wall a stand-pipe 7 ft. in diam. by 30 ft. high.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. *Taps*, 500. *Meters*, 1. *Hydrants*, Ludlow, 16. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 27 lbs. Fire, 110 lbs.

Financial.—Cost, $25,000. Capital stock, $15,000. Bonded debt, $7,500. Int., 4%. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,000; city, $160. Hydrant rental, $7.

Management.—Prest., C. H. Zehnder. Secy., G. L. Reagan. Treas., S. C Jayne. Supt., Geo. Depuy.

BIRDSBOROUGH, *Berks Co.* (Pop., 1,705; est., 2,800.) In hilly country on Schuylkill river, 8 miles from Reading. Engaged in iron manufacturing. Settled in 1740; incorp. a borough in '72.

History.—Built in '84 by the E. & G. Brooke Iron Co. Engr., Isaac S. Cassin, Philadelphia. Contrs., Denithorne Bros, Phœnixville.

Water Supply.—Indian run, fed by mountain springs, by gravity from impounding reservoir. The stream has a drainage area of 2½ sq. m.

Reservoir and Dam.—Cap., 25,000,000 galls. The dam is of earth, 375 ft. long, 30 ft. high, with outer slopes 1½ to 1, inner, 2¼ to 1, the latter having a 12-in. paving. The reservoir is 200 ft. above, and 2½ miles from, town, and water is conveyed thence by 12 and 10-in., and distributed by 10 to 4-in. pipe.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, galv. i., lead. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading. *Taps*, est., 300. *Meters*, none. *Hydrants*, Cassin, 36.

Consumption, about 3,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $55,000. No stock, bonds or debt. Ann. op. exp., slight. No further data given, save that the Co. are the principal consumers.

Management.—Prest., Geo. Brooke. Treas., Geo. W. Harrison. Supt., Ward Harrison.

BLAIRSVILLE, *Indiana Co.* (Pop., 1,162; est., 1,600.) On Conemaugh river, at base of first bench of Allegheny mountains on the west, in fine farming country. Settled early in last century; incorp. a borough in '25.

History.—Built in '72 by borough. Engr., Robt. Neilson. Built by day's labor under supervision of borough.

Water Supply.—Conemaugh river, pumping to reservoir.

Pumping Machinery.—McKnight pump, dy. cap., 160,000 galls.

Reservoir.—Cap., 200,000 galls.; 60 ft. in. diam., 8 ft. deep, of stone masonry, and about 112 ft. above highest part of town.

Distribution.—*Mains*, c. i., 3½ miles. The pipe was first of wood wrapped with tarred iron, but it gave continual trouble, and has been replaced with c. i. *Services*, lead. *Taps*, 321. *Meters*, none. *Hydrants*, Bailey, Mathews, 33.

Consumption, 160,000 galls. *Pressure*: 30 to 50 lbs.

Financial.—Cost, about $25,000. Bonded debt, $15,000. Int., 4%. Ann. op. exp., $1,200. Ann. rev.: consumers, $4,800.

Management.—Water Comm. Supt., Jno. F. Kalback. Report made by Theo. Vandivort.

BLOOMSBURGH, *Columbia Co.* (Pop., 3,702; est., 5,000.) On north branch of Susquehanna river. Engaged in iron manufacturing, and is in farming country.

History.—Built in '80 by Bloomsburgh Water Co. Engr., H. P. M. Birkinbine, Philadelphia, now deceased.

Water Supply.—Fishing creek, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., 1,200,000 galls.; one horizontal and two vertical tubular boilers.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 9. *Hydrants*, Birkinbine, Ludlow, 45. *Valves*, Cassin.

Consumption, 300,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $45,208. Capital stock, $30,000. Bonded debt, $8,000. Int., 5%. Ann. op. exp., $2,228. Ann. rev.: consumers, $4,883; city, $900.

Management.—Prest., Jno. A. Funston. Secy. and Treas., Frank P. Billmeyer. Supt., G. W. Welliver.

BOYERTOWN, *Berks Co.* (Pop., 1,099; [est., 2,200.) Manufactures cigars, and is in a rich agricultural and mining region.

History.—Built by Boyertown Water Co., date not given. Des. Engr., Jno. Schaeffer. Const. Engr. and Contr., Jno. G. Schealer.

Water Supply.—Springs, by direct pumping from reservoir.

Pumping Machinery—Not given.

Reservoir.—Cap., 25,000 galls.

Distribution.—*Mains*, 3 miles. *Hydrants*, 6, or more. No further data given.

Financial.—Not given.

Management.—Supt., Jeremiah Sweinhart.

BRADFORD, *McKean Co.* (Pop., 9,197: est., 11,000.) At junction of [two streams forming Tunungnant creek, in the valley and on the slopes of the hills, which rise 500 ft. above creek. The city is 1,444 ft. above the sea. In centre of rich oil region. Settled in '40; incorp. a city in '79.

History.—Now owned by city; built in '77 by Bradford Water-Works Co., and bought by city in '81, for $19,400. There is also in the town a system for supplying coke works, owned by the Youghiogheny Water-Works Co. The plant includes a 2,000,000-gall. reservoir, filled from stream by pumping through 2¼ miles of pipe, there being two Cope & Maxwell pumps. In addition to the reservoir, a number of tanks give a storage capacity of over 1,000,000 galls. The system was completed in about '81 and at that time supplied nearly 1,000 coke ovens. Further data is given in *Eng. News*, vol. VIII. p. 513.

Water Supply.—Marilla and Gilbert brooks, by gravity from impounding reservoirs. Direct pumping was originally used, there being two 9-in. Cameron steam pumps, but with the completion of the new Gilbert brook reservoir in '87 the pumping station was abandoned. Under the old system a 50,000-gall. wooden tank was used to equalize the pressure.

Reservoirs.—Combined cap., 24,000,000 galls. The one on Marilla brook has a cap. of 4,000,000, that on Gilbert brook of 20,000,000 galls. The new reservoir built in '87 was designed by the city Engr., J. A. Seymour. Contrs., J. & M. McMahon. The pipe connecting the new reservoir with the old conduit was bought of the Jackson & Woodin Mfg. Co., Berwick.

Distribution.—*Mains*, c. i., w. i., 15.76 miles. *Services*, w. i. *Taps*, 994. *Meters*, none, *Hydrants*, Ludlow, 57. *Gates*, Ludlow, 192.

Consumption, 1,120,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Cost, $100,000. Debt, $60,000. Int., 6%. Ann op. exp., about $5,000, Ann. rev.: total $13,643. No allowance for hydrants.

Management.—Three Commrs. Chairman, A. W. Newall. Supt. and Clerk, C. J. Lane.

BRISTOL, *Bucks Co.* (Pop., 5,273; est., 7,000.) On Delaware river, on nearly level ground, 12 ft. above high water in river. Has yarn, hosiery, carpet and rolling mills and a large foundry. Settled in 1684.

History.—Built in '74-5 by Bristol Water Co. Engr., Wm. E. Morris. No general contractor, work being done by the day, under direction of Co.

Water Supply.—Delaware river, pumping to stand-pipe.

Pumping Machinery.—Combined dy. cap., 3,000,000 galls.; one 2,000,000-gall compound condensing, and two 500,000-gall, high-pressure Worthington pump.

Stand-Pipe.—Is 6 ft. in diam. and 140 ft, high; furnished by Henry G. Morris Philadelphia.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, and A. H. McNeal & Co., Burlington, N. J. *Taps*, 575. *Meters*, 1. *Hydrants*, Mathews, 51. *Valves*, Eddy, Chapman.

Consumption, 600,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Capital stock, $50,000. No debt. Ann. op. exp., $3,000. Ann. rev.: consumers, $9,000; city, $600, for hydrants and all purposes,

Management.—Presᵗ., A. Swain. Treasˢ., L. A. Hoguet. Clerk, G. M. Dorrance. Supᵗ., A. K. Joyce. Report made by Chas. E. Scott, Director.

BROOKVILLE, *Jefferson Co.* (Pop., 2,136; est., 3,200.) On Red Bank creek at the junction of North Fork and Sandy Lick creeks, on three hills, the surrounding country being very rough. Engaged in lumber business. Settled in '30; incorp. a borough in '31.

History.—Built in '83 5 by Brookville Water Co., under the direction of W. D. J. Martin, the labor being by the day.

Water Supply.—North Fork creek, pumping to tank. Creek has a drainage area of 30 sq. m.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls.

Tanks.—Combined cap., 100,000 galls.; two wooden tanks, set on framework 4 ft. above the ground, and being 150 ft. above main part of town.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 160. *Meters*, none. *Hydrants*, Hutchinson & Alexander, 24. *Valves*, kind. do.

Consumption, unknown. *Pressure*: Ordinary, 88 lbs. Fire, 88 lbs.

Financial.—Cost, $28,000. Capital stock, $28,000. No debt. Ann. op. exp., $1,200. Ann. rev.; consumers, $2,000: city, $492. Hydrant rental, $25 for first 12, and $16 for each additional.

Management.—Prest., E. A. Litch. Secy. and Treas., W. D. J. Martin. Supt., W. R. Ramsey.

BUTLER, *Butler Co.* (Pop., 3,163; est., 6,000.) On Conoquenessing creek. Manufactures flour, plate glass, bottles, sash and doors, and woolen goods, and is in an agricultural, mining and natural gas district.

History.—Built in '78 by Butler Water Co.

Water Supply.—Conoquenessing creek, pumping to reservoir.

Pumping Machinery.—Keystone pump, dy. cap., not given.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, 350. *Meters*, none. *Hydrants*, (in '86.) 50: kind not given.

Consumption, (in '86.) 216,000 galls. *Pressure*: Ordinary, 110 lbs.

Financial.—Cost, not given. Capital stock, $75,000. Debt, not given. Int., 6%. No further data given.

Management.—Prest., W. G. Brandon. Supt., Secy. and Treas., W. B. Meredith.

CANTON, *Bradford Co.* (Pop., 1,194; est., 1,400.) Has foundry and lumber mill.

History.—Built in '80 by Citizen's Water Co.

Water Supply.—Mountain brook, by gravity. There is a dam across ravine forming reservoir.

Distribution.—*Mains*, iron, about three miles. *Service*, iron. *Taps*, about 250. *Meters*, none. *Hydrants*, kind not given, 14.

Consumption, unknown. *Pressure*: not known, but heavy.

Financial.—Ann. op. exp., $450. Ann. rev.: consumers, $1,600; city, $200 for all hydrants village cares to put in.

Management.—Prest., G. W. Maynard, Williamsport. Supt., Geo. A. Guernsey.

CARBONDALE, *Lackawanna Co.* (Pop., 7,714; est., 10,000.) On Lackwanna river, at head of Lackawanna valley between Moosic and Greenfield mountains, in coal country. Settled in '28; incorp. a city in '51.

History.—Built in '68 by Crystal Springs Water Co.

Water Supply.—Springs, by gravity from two storage to distributing reservoirs. The first of the former was built by Delaware & Hudson Canal Co, on headwaters of Racket brook, about 2 miles from city, and is formed by an earth dam, with timber bulkhead. No further description of the storage reservoirs is given, save that one has an area of 30 and the other of 10 acres.

Conduit.—Between reservoirs, 6,000 ft. of wrought iron and cement pipe.

Distributing Reservoir.—In earth-work, 250 ft. above city, with area of 3 acres and depth of 8 ft.

Distribution.—*Mains*, c. i., w. i. and cement, 8 miles. *Services*, galv. iron, lead. *Taps*, 550. *Meters*, none. *Hydrants*, Philadelphia, 36. *Valves*, Ludlow.

Consumption, est., 150,000 galls. *Pressure*: Ordinary, 90 lbs.

Financial.—Cost, $24.500. Capital stock, $23,200. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, $7,500; city, $900. Hydrant rental, $25.

Management.—Prest., R. Mamille. Secy., L. Egerton. Supt., W. McMullen.

CARLISLE, *Cumberland Co.* (Pop., 6,209; est., 9,000.) In broken rocky, region having some manufactories. Settled in 1750; incorp. a borough in 1782, and had its charter amended in '14.

History.—Built in '55-6 by Carlisle Gas & Water Co. Des. Engr., A. T. Smith.

Water Supply.—Conodoquinnet creek, pumping to reservoir. A dam across stream, three miles from town, furnishes water-power for pumping.

Pumping Machinery.—Cap., 1,000,000 galls.; the first pump was made by F. Gardner, Carlisle, and was a horizontal piston pump of 300,000 gall. cap., driven by a 6 ft. Leffel turbine under 4½ ft. head. In '81-2 a Dean steam pump was added.

Reservoirs.—Cap., 2,500,000 galls.; two, in excavation, lined with brick masonry each 124 by 132 ft., by 12 ft. deep; on hill midway between pumps and town, 125 ft. above pumps, and 745 ft. above town.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead. *Taps*, 550. *Meters*, none. *Hydrants*, 70; old ones made by Morris, Tasker & Co., new are Mathews.

Consumption, 750,000 galls. *Pressure*: not given.

Financial.—In '82 the cost of gas and water-works together had been $90,661. The total capital stock is now $58,000. Debt, $9,000 Int., 5 and 6%. Ann. op. exp. chargeable to water department for year ending May 1, '88, $1,808. Ann. rev.: for same time, consumers, $5,367; city, $250. Hydrant rental $5. Seel.supplement.

Management.—Prest., Lemuel Todd. Supt. and Secy. Chas., E. Ramsey.

ATASAUQUA, *Lehigh Co.* (Pop., 3,065; est., 3,500.) On Lehigh river, in hilly country. Manufactures iron. Settled in '40.

History.—Built in '42 by Crane Iron Co.

Water Supply.—Lehigh river, pumping to reservoir and stand-pipe from feeder connecting river with Lehigh canal.

Pumping Machinery.—Cap., 80,000 galls. Two double acting pumps, with 6-in. bore and 48-in. stroke, driven by water-power.

Reservoir.—Cap., about 300,000 galls.; is 125 ft. above pumps; of masonry in cement, 60 ft. sq. and 12 ft. deep.

Stand-Pipe.—Is 127 ft. high and 5 ft. in diam. at base.

Distribution.—*Mains*, c. i., 3 miles. *Services*, lead. *Taps*, (in '86,) 350. *Meters*, none. *Hydrants*, kind not given, 45.

Consumption, 50,000 galls. *Pressure*: Ordinary, 50 lbs.

Financial.—Cost, $50,000. No debt. Ann. op. exp., not given. Ann. rev.: consumers (in '85,) $2,600; city, $540. Hydrant rental, $12.

Management.—Supt., W. R. Thomas.

CENTRALIA, *Columbia Co.* (Pop., 1,886.)

General Description.—Built sometime prior to '84 by Centralia Water Co. The supply is sometimes inadequate, when water is taken from Locust Mountain Water Co.'s works, or those of the Lehigh Valley R. R. Co. No other data can be obtained in time for insertion here. If given later it will be found in the supplement.

CHAMBERSBURGH, *Franklin Co.* (Pop., 6,877; est., 9,000.) On Conococheague creek, on rolling ground. Manufactures steam engines and milling machinery. A very old town.

History.—Built in '76 by town. Engr., H. P. M. Birkinbine, Philadelphia, deceased.

Water Supply.—Surface water, from impounding reservoir on stream, pumping to reservoir, and direct pumping for fire purposes.

Pumping Machinery.—Birkinbine pump, dy. cap., not given.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 8.5 miles. *Services*, galv. i., lead. *Taps*, 817. *Meters*, none. *Hydrants*, Birkinbine, Mathews, 67.

Consumption, about 450,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 70 lbs.

Financial.—Cost, $53,000. Debt, $45,000. Int., 6 %. Ann. op. exp., $2,300. Ann. rev.: consumers, $7,000; city, none.

Management.—Supt., A. C. McGrath.

CHESTER, *Delaware Co.* (Pop., 14,997; est., 20,000.) On Delaware river, 15 miles from Philadelphia. Has good harbor, considerable commerce, and is engaged in ship-building and manufacturing. Settled in 1643 and was originally called Upland.

History.—Partially supplied in 67 'by works built by the South Ward of the city. Engr., Isaac S. Cassin, Philadelphia. In '86 works were begun by New Chester Water Co., and put in operation June 1, '88. Engr., E. F. Fuller, New York City. Contr., Samuel R. Bullock, New York City.

The old system took its supply from the Delaware river, a 12-in. cast-iron pipe extending 400 ft. into the stream, its outer end resting on a flat rock in 15 ft. of water at low tide. A 25 H. P. steam engine drove a pump built by C. A. Weidner, lifting water 106 ft. high to a 1,000,000-gall. distributing reservoir. In '78 this system had 12 miles of pipe, 1,100 taps and 57 hydrants. The original cost of these works was $79,000 and they were built by bonds issued on the real estate of the ward.

The description below is of the new system.

Water Supply.—Deleware river, pumping to reservoir, or by direct pumping, if desired.

Pumping Machinery.—Cap., 10,000,000 galls.; two horizontal compound condensing pumping engines.

Reservoir.—Cap., 15,000,000 galls.

Distribution.—*Mains*, c. i., 40 miles. *Services*, w. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia. *Taps*, 2,200. *Meters*, 15. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: not given.

Financial.—Cost, $4,250,000. Capital stock, $2,000,000. Bonded debt, $1,000,000 Ann. op. exp., $7,500. Ann. rev.: consumers, $57,425; city, $3,000. Hydrant rental, $40.

Management.—Prest., J. L. Forwood. Treas., E. Woltmann. Secy., W. H. Miller. Supt., W. Shaler Johnson.

CLARION, *Clarion Co.* (Pop., 1,169; est., 1,600.) On hilly ground on Clarion river, in oil, lumber and mining region. Settled in '39; incorp. a borough in '40.

History.—Built in '75 by Clarion Water Co. Des. Engr., H. E. Rigley. Const. Engr., C. B. Thomas.

Water Supply.—Clarion river, pumping to tanks.

Pumping Machinery.—Dy. cap., 48,000 galls.; Eclipse pump, furnished by Keystone Pump Works, Pittsburgh.

Tanks.—Combined cap., 96,000 galls.; two similar wooden tanks, 59 ft. above town.

Distribution.—*Mains*, c. i., 2.5 miles. *Services*, w. i., lead. *Taps*, 120. *Meters*, 2. *Hydrants*, Hutchinson & Alexander's, 11.

Consumption, 40,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $15,000. Capital stock, $12,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,000; city, $132. Hydrant rental, $12.

Management.—Prest., W. Corbett. Secy., C. A. Rankin. Treas., N. Meyers. Supt., R. B. Thomas.

CLEARFIELD, *Clearfield Co.* (Pop., 1,809; est., 3,000.) On west branch of Susquehanna river. Manufactures lumber and fire brick, and is engaged in agriculture, and coal mining. Settled in '20: incorp., a borough in '30.

History.—Built by Clearfield Water Co. in '82-3. Engr. and Contr., Geo. B. Inman, New York City.

Water Supply.—Moose creek, by gravity. The creek is a mountain stream, having a flow in the dryest season largely in excess of the cap. of supply pipe, which is of 10-in. cast-iron. Water is diverted to the pipe by a dam 4 ft. high and 35 ft. long, at a point 3 miles from town and 190 ft. above its highest level.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 36. *Valves*, R. D. Wood & Co.'s.

Consumption, unknown. *Pressure*: Ordinary, 75 lbs. Fire, 85 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000. No debt. Ann. op. exp., $800. Ann. rev.: consumers, 4,500; city, $700.

Management.—Prest., W. W. Betts. Supt., Secy. and Treas., H. F. Bigler.

COATESVILLE, *Chester Co.* (Pop., 2,766: est., 3,000.) On Brandywine creek on rolling ground. Has iron, paper and woolen mills. Settled in 1780; incorp. a borough in '64.

History.—Built in '70-1 by borough. Engr., Isaac S. Cassin, Philadelphia. Not built by contract.

Water Supply.—Springs, by gravity from collecting to distributing reservoir.

Collecting Reservoir.—Cap., 1,000,000 galls.; formed by a small rubble stone masonry dam ½ mile from springs.

Conduit.—Between reservoirs; 2,200 ft. of 10-in. cast-iron pipe.

Distributing Reservoir.—Cap., 300,000 galls; in excavation and embankment near, and 121 ft. above, town.

Distribution.—*Mains*, c. i., 4.7 miles. *Services*, lead, iron. *Taps*, 867. *Meters*, none. *Hydrants*, kind not given, 53.

Consumption, 120,000 galls. *Pressure*, Ordinary, 35 lbs.

Financial.—Cost, $60,000. Bonded debt, $82,000. Int., 4%. Ann. op. exp., $250. Ann. rev.: consumers, $3,802; city none.

Management.—Chairman Water Comm. and Supt., L. H. Humphrey. Secy. Borough Council, Isaac Spoekman.

COLUMBIA, *Lancaster Co.* (Pop., 8,312; est., 10,000. On Susquehanna river, 27 miles from Harrisburg. Engaged in manufacturing iron and stoves.

History.—Built in '23-6 by Columbia Water Co. No Engr.

Water Supply.—Susquehanna river, and spring, by gravity, and by pumping to reservoir.

Pumping Machinery.—Cap., 1,200,000 galls.: Worthington high-pressure pump.

Reservoirs.—Two, each 150 by 200 ft., by 12 ft. deep.

Distribution.—*Mains*, iron, 12 miles. *Services*, w. i. *Taps*, (in '82,) 1,600. *Meters*, 2. *Hydrants*, kind not given, 62, in '82.

Consumption, 400,000 galls. *Pressure*: Ordinary, 60 lbs, Fire, 60 lbs.

Financial.—Cost, $150,000. Debt, $70,000. Int., 5%. Ann. op. exp., $5,000. Ann. rev.: consumers, in '81, $15,000; city, none.

Management.—Prest., J. D. Meyers, Secy., J. C. Clark, Supt., Wm. B. Fasig.

CONEMAUGH, *Cambria Co*, (Pop., 3,498.) A suburb of Johnston, Cambria Iron and Steel Works are located here.

History.—A blast furnace, the railroads and about 15 residences have been supplied since '76 by the Johnstown Water Co., by tapping a 20-in. main extending from a dam above Conemaugh to Johnstown. The Cambria Iron Co. have a direct pumping system through a 30 in. main, which is entirely for their own use. There are no fire hydrants. All data included under Johnstown.

CONNELLSVILLE, *Fayette Co.* (Pop., 3,609; est., 5,000.) On the Youghiogheny river, on undulating ground. Has coke, limestone, iron and lumber industries.

History.—Supplied in '83 by a private company, the works being completed in '87 by the Connellsville Water Co., controlled by the American Water-Works & Guarantee Co., Pittsburgh. The franchise is for 20 years. The works as first constructed were designed by C. W. Knight, Rome, N. Y., and Adam Miller. The works supply New Haven.

Water Supply.—Springs, by gravity from two impounding reservoirs.

Reservoirs.—Combined cap., 20,000,000 galls.; the first one built has a cap. of 5,000,000 galls., and is formed by an earthen dam across a ravine; the second one has a cap. of 15,000,000 galls.

Distribution.—*Mains*, c. i., 14.6 miles. *Services*, galv. i. *Taps*, 550. *Meters*, not given. *Hydrants*, kind not given, 75.

Consumption, not given. *Pressure*: Ordinary, 100 lbs.

Financial.—Cost, $120,000. Capital stock, $250,000. Bonded debt, $95,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $2,960. Hydran rental, $40.

Management.—Genl. Mgr., W. S. Kuhn, Pittsburgh. Supt., Geo. Munson.

CONSHOHOCKEN, *Montgomery Co.* (Pop., 4,561; est., 7,000.) On Schuylkill river, 14 miles above Philadelphia. Manufactures gas and water pipe, woollen and worsted goods, carpets, railroad cars, and iron goods.

History.—Built in '73 by Conshohocken Gas and Water Co. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Schuylkill river, at the Plymouth dam, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington pumps, each of 1,000,000 galls. cap., the old pump having two 20-in. steam and two 10-in. water cylinders and the new one being a compound condensing pump.

Reservoir.—Cap., 1,250,000 galls.; is 185 ft. above the pumps, in two compartments, with division wall and embankments carried 6 ft. above, and the basins excavated 6 ft. below, ground level. Slopes and bottom are lined with 18 in. of clay, paved with brick and grouted with cement. The reservoir has given much trouble by breaking, and parts of its slopes and lining have been rebuilt.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 370. *Meters*, 20. *Hydrants*, Mathews, 51.

Consumption, 175,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $80,000. Capital stock, $70,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1698. Ann. rev.: consumers, $5,511; city $862. Hydrant rental, $12 for all over 25, a 20 years' contract.

Management.—Prest., Inwood Lukens. Supt., Wm. E. Ferrier.

CORRY, *Erie Co.* (Pop., 5,277. est., 8,000.) A railroad and manufacturing center.

History.—Built in '86 by Corry Water Co., under a 10 years' franchise. Engr., Ellis Morrison, New York City. Contr., Saml. R. Bullock, New York City.

Water Supply.—Hare creek, pumping from impounding to distributing reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two compound condensing Holly-Gaskill pumps. The boilers were made by Corry City Iron Works.

Reservoir.—*Impounding*: unofficially reported as having a cap. of 20,000,000 galls. *Distributing*: is 160 by 80 ft., by 20 ft. deep.

Distribution.—*Mains*, c. i. 8.5 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville Ky. *Taps*, 240. *Meters*, not given. *Hydrants*, Ludlow 60. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 85 lbs. Fire, 150 lbs.

Financial.—Cost, $130,000. Capital stock, $200,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $4890; city, $3,000. Hydrant rental, $50.

Management.—Prest., J. L. Brown. Treas., E. Woltman. Secy., E. Morrison.

DANVILLE, *Montour Co.* (Pop., 8,346; est., 9,000.) On north branch of Susquehanna river, at the foot of Montour ridge, which rises to an elevation of about 450 ft. The valley at this point is about ¾ miles wide. Has iron works and various other manufactories. Laid out and settled in 1792 by Danl. Montgomery; incorp. a borough in '49.

History.—Built in '73 by borough. Des. Engrs., Holly Manufacturing Co., Lockport, N. Y. Const, Engr., O. H. Ostrander.

Water Supply.—North branch of Susquehanna river, direct pumping from filter gallery, or well, near the river. The difference between extreme high and low wate is 25.8 ft.

Filter and Pump-Well.—At first water was filtered through 45 in. of gravel placed in a timber frame 12 by 45 ft. in size, and from the bottom of this filter it entered the pump-well through drain-tile. This was used until '80, when it was inadequate, and a trench was sunk near the shore, 90 by 7½ ft., by 10 ft. deep, its bottom being 5 ft. below extreme low water. The sides of the trench, or well, were lined with ¾-in. cast-iron plates, riveted together and cross-braced with iron rods. The well is covered with riveted cast-iron plates, and air supplied through a 4-in. pipe. The well has given satisfaction. Its filtering cap. in '81 was about 150 galls. per sq. ft. per day.

Pumping Machinery.—Dy. cap., 612,000 galls.; Holly pump.

Distribution.—*Mains*, c. i., 13 miles. *Services*, iron, lead. Pipe and specials furnished, and pipe laid, by Keller & Krebs. *Taps*, 1,000. *Meters*, none. *Hydrants*, Holly, about 100. *Valves*, Ludlow.

Consumption, 612,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $169,000. Bonded debt, $110,000. Int., 4%. Bonds have been issued to the full amount of $169,000 but $59,000 of the bonds have been redeemed Ann. op. exp., $5,000. Ann. rev.: total, $7,600.

Management.—Three Commrs. Supt., Schwartz Miller. City Clerk, Ben. J. Harris, Jr.

DOWNINGTON, *Chester Co.* (Pop., 1,480; est., 2,000.) Manufactures paper, woolen goods, stoves and machinery.

History.—Built in '74 by Downington Gas & Water Co., which was chartered in '67 and began construction in '71. Des. and Const. Engrs., Joshua Kames and Jno. B. Stevenson.

Water Supply.—Springs, by gravity from reservoirs.

Reservoirs.—Three, the first being a collecting reservoir. They are: 75 by 90 ft. by 6 ft deep; 50 ft. sq. by 6 ft. deep; 30 ft. in diam. by 10 ft. deep.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i., lead. *Taps*, 332. *Meters*, none. *Hydrants*, 1.

Consumption, unknown. *Pressure*: Ordinary 32 lbs. Fire, 32 lbs.

Financial—Cost, about $60,000. Debt, $10,500; $4,000 being 7% bonds and $6,000 notes at 6%. Ann. op exp., about $400. Ann. rev: consumers, $4,700, of which $2,000 is from the Penn. R. R. Co,

Management.—Prest., P. C. Hollis. Secy. and Treas., Jos. L. Richards. Supt., Jas. Hamilton.

DOYLESTOWN, *Bucks Co.* (Pop., 1,859; est., 2,500.) In an agricultural district.

History.—Built in '69 by borough. Engr., Isaac S. Cassin. Contr., I. S. Cassin & Co., Philadelphia. Sub-Contr. for buildings, H. Livezy, Doylestown; for masonry, Frank Aldeman.

Water Supply.—Springs, pumping to reservoir, and direct pumping for fire purposes.

Pumping Machinery.—Holly-Gaskill horizontal compound pump, dy. cap., 1,500.0 0 galls.

Reservoir.—Is 60 ft. in diam. and 20 ft. deep.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 425. *Meters*, none. *Hydrants*, Cassin, 41. *Valves*, Cassin.

Consumption, 75,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 140 lbs.

Financial.—Cost, $35,000. Bonded debt, $30,000. Int., 4%, Ann. op. exp., $1,300. Ann. rev., consumers: $4,500; city, none.

Management.—Prest., Dr. O. P. James. Secy., J. E. Torns. Supt., S. L. Freed. Secy., Wm. J. Wintyen.

DUKE CENTER, *McKean Co.* (Pop., est., 700.)

General Description.—A fire protection system, consisting of 1.3 miles of mains 13 hydrants, a force pump, and a storage tank with cap. of about 40,000 galls., situated on a hill above the village. Steam for pumping is furnished from the pumping station of the National Transit Co. Ann. op. exp., $10. Address G. H. Dana. Report made by P. L. Golden.

DUNMORE, *Lackawanna Co.* (Pop., 5,151; est., 7,000.) In coal region, 2 miles from Scranton.

History.—Built in 69-70 by Dunmore Gas & Water Co., from plans and under supervision of the Prest., Jno. B. Smith.

Water Supply.—Surface water, by gravity.

Distribution.—*Mains*, w. i. and cement, 5 miles. *Services*, galv. i. *Taps*, 460. *Meters*, Worthington, 6. *Hydrants*, kind not given, 4.

Consumption, not given. *Pressure*: Ordinary, 100 lbs.

Financial.—Capital stock, $150,000. ‡Debt, not given. Int., 5%. Ann. op. exp. and Ann. rev. from consumers and city, withheld.

Management.—Prest., Jno. B. Smith. Secy. and Treas., Chas. P. Savage.

EAST BRADY, *Clarion Co.* (Pop., 1,242; est., 1,500.) Engaged in coal mining.

History.—Built by Cunningham & Foster, date not given.

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Dy. cap., 20,000 galls.

Tank.—Is 50 ft. diam. and 25 ft high.

Distribution.—*Mains*, ½ miles. *Services*, not given. *Taps*, 2. *Meters*, 2. *Hydrants*, not given.

Consumption, not given. *Pressure*: Fire, 90 lbs.

Financial.—Not given.

Management.—Supt., J. M. Cunningham.

EAST MAUCH CHUNK, *Carbon Co.* (Pop., 1,853.) On Lehigh river, opposite Mauch Chunk, in coal region.

History.—Built for domestic supply in '51 by Mauch Chunk Water Co.

Water Supply.—Two small streams, by gravity from an impounding reservoir n each.

All further data included under Mauch Chunk.

EASTON, *Northampton Co.* (Pop., 11,924; est., 15,000.) On Delaware river, on hilly ground between mouths of Bushkill creek and Lehigh river. Engaged in manufacturing and trade. Settled in 1738; incorp. a borough in 1789.

History.—First supplied in '20 by a private company, but no account of these works has been given. Present system built in '54 by Lehigh Water Co. Des. Engr., Jno. West; and for new pumping system put in in '82, H. P. M. Birkinbine, Philadelphia, now deceased. In '82 a portion of Phillipsburg, N. J., across the river, was supplied by this Co.

Water Supply.—Delaware and Lehigh rivers, pumping through distribution mains to reservoir.

Pumping Machinery.—Dy. cap., 5,000,000 galls. The first of the present pumps was erected in '60, and was a Cornish Bull engine. In '82 a 2,000,000-gall. Corliss pump was added, and later a Worthington pump was added.

Reservoir.—Cap., 4,000,000 galls. In '81, one of the reservoirs sprung a leak near bottom and all but 2-ft. in depth of its contents escaped before the hole could be stopped. The reservoir was 180 ft. sq. and 12 ft. deep. The water escaped through a subterranean channel.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., galv. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 1,209. *Meters*, 50. *Hydrants*, Cassin, 85. *Valves*, Cassin.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 20 to 100 lbs. Fire, do.

Financial.—No data given for '88, but in '85 the following figures were given: cost, $300,000. Debt, $26,000. Int., 6%. Ann. op. exp., $10,000. Ann. rev.: consumers $24,000; city none. In '82 the capital stock was $200,000.

Management.—Prest., J. S. Rodenbaugh. Treas., J. Rader. Supt., R. P. Rader.

EBENSBURGH, *Cambria Co.* (Pop., 1,123; est., 1,200.) In the Allegheny mountains, 2,000 ft. above the sea. Manufactures leather, lumber and woolen goods. Settled in 1795; incorp. a borough in '06.

History.—Built in '74 by borough. Des. Engr., Jas. Williams.

Water Supply.—Artesian well, pumping to reservoir, with an auxiliary supply from pond formed by damming a creek. Well is 5¾ in. in diam. and 1,000 ft. deep.

Pumping Machinery.—Dy. cap., 288,000 galls.; a 3-in. Cameron pump is driven by a windmill, supplemented by steam power, and lifts water 30 ft. to reservoir.

Reservoir.—Cap., 150,000 galls.; stone, 50 ft. in diam. by 10 ft. deep, and 75 ft. above town.

Distribution.—*Mains*, c. i., 1.5 miles. *Services*, w. i. *Taps*, 60. *Meters*, 3. *Hydrants*, R. D. Wood & Co., 16.

Consumption, not given. *Pressure*: Ordinary, 35 lbs.

Financial.—Cost, $16,000. Debt, $6,700. Int., 4%. Ann. op. exp., $500. Ann. rev: consumers, $1,300; city, none.

Management.—Supt., R. L. Thomas.

EDENBURG, (*Knox P. O.*) *Clarion Co.* (Pop., 1,020.) Has machine shops, planing mills and several oil wells.

History.—Controlled by Borough Council; built by Edenburg Water Co., date not given. Principally for fire protection.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Not described.

Tank.—Cap., about 40,000 galls.

Distribution.—*Mains*, 2,000 ft. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 5.

Consumption, not given. *Pressure*: Ordinary, 75 lbs.

Financial.—Cost, $2,000. Debt, $125. Int., 6%. Ann. op. exp., $200. Ann rev.: not given.

Management.—Borough Council. Burgess, A. J. Smith. Treas., Smith & Corlett. Secy., J. J. Cortlett. Supt., Robert Cortlett. Report made by N. N. Booth, Town Secy.

ELDRED, *McKean Co.* (Pop., 1,165; est., 1,200.) On Allegheny river, in coal region. Has some manufactories.

History.—Built by private subscriptions for fire protection, date not given.

Water Supply.—River, pumping to tank.

Pumping Machinery.—Cameron pump, dy. cap., about 250,000 galls.

Tank.—Cap., about 40,000 galls.

Distribution.—*Mains*, w. i., about 2 miles. *Hydrants*, kind not given, 18. *Pressure*: 110 lbs.

Financial.—Cost, $3,000. No debt. Ann. op. exp., $100.

Management.—Five Commrs. Town Clerk, A. H. Mayo.

EMAUS, *Lehigh Co.* (Pop., 847; est., 1,200.) In mountainous farming country. Settled by Moravians in 1747; incorp. a borough in '58. Has pipe foundry.

History.—Built in '71 by borough. Engrs., Lehr & Emery, Allentown.

Water Supply.—Two springs on Lehigh mountain, by gravity, to and from reservoirs.

Reservoirs.—One 40 by 80 ft., by 12 ft. deep, and one 16 by 32 ft., by 12 ft. deep; of masonry laid in, and lined with cement. Is ½ mile from, and 250 to 300 ft. above village.

Distribution.—*Mains*, c. i., (in '84.) 2 miles. *Services*, w. i. *Taps*, about 200. *Meters*, none. *Hydrants*, kind not given, (in '84.) 10.

Consumption, not given. *Pressure*: 100 ft. head.

Financial.—Cost, $17,500. Bonded debt, $11,000, $6,500 having been paid. Int., 4%. Ann. op. exp., $50. Ann. rev.: consumers, about $875: city, none.

Management.—Supt., Tilghman Wickert. Report made by H. W. Janett.

EMLENTON, *Venango Co.* (Pop., 1,140; est., 1,500.) On Alleghany river, in fine farming country.

History.—Built in '78 by Emlenton Water Co.

Water Supply.—Springs and river, by gravity and pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., not given.

Reservoir.—Cap., 325,000 galls.

Distribution.—*Mains*, iron, 2 miles. *Services*, iron, lead. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 10.

Consumption, not given. *Pressure*: Ordinary, 125 lbs. Fire, 125 lbs.

Financial.—No data given, save est. ann. op. exp., $750.

Management.—Prest., C. C. Cooper. Secy. and Treas., J. J. Gosser. Supt., D. D. Moriarty.

EMPORIUM, *Cameron Co.* (Pop., 1,156: est., 2,000.) Has foundry, machine shops, saw mills, tannery, and saw, lathe and picket manufactories.

History.—Built in '87-8 by private company. Engr., C. W. Knight, Rome, N. Y. Contrs., R. D. Wood & Co., Philadelphia, who furnished all material.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 1,500,000 galls.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, galv. i., lead. *Taps*, 110. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 120 lbs.

Financial.—Cost, $33,000. Capital stock, $30,000. Debt, $2,500. Int., 5%. Ann. op. exp., $25. Ann rev., at present: consumers, $1,400; city, $1,000. Hydrant rental, $40 a ten years' contract for 25.

Management.—Prest. and Genl. Supt., J. F. Parsons. Secy., J. P. Felt. Treas., W. S. Walker.

EUPHRATA, *Lancaster Co.* (Pop., 392.) On Cocalico creek, in an agricultura district. Settled early in the 18th century by religious sect called Dunkers.

History.—Built in '79 by Euphrata Water Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 60,000 galls.

Distribution.—*Mains*, 4 and 6-in. c., i. 4,000 ft. *Services*, w. i. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given.

Consumption, 1,000 galls. *Pressure*: Ordinary, 70 lbs.

Financial.—Cost, $4,000. Capital stock, $5,000. No debt. Ann. op. exp., nominal. Ann. rev.: consumers, $265; village, not given, 6.

Management.—Prest., R. R. Bitzer. Report made by E. S. Royer.

ERIE, *Erie Co.* (Pop., 27,737; est., 35,000.) On Lake Erie, on an elevated bluff. Engaged in manufacturing and lake commerce, and has natural gas wells. The site was occupied in 1749 by a French fort, and the town laid out in 1795; incorp. a borough in '05, a city in '51.

History.—First supplied in '40 from spring, through wooden pipes. There were several reservoirs for fire protection and a number of private consumers. The present works were built in '67-9 by city. Engr., H. P. M. Birkinbine.

Water Supply.—Lake Erie, pumping through stand-pipe to reservoir.

Intake Pipe.—A 48-in. cast-iron pipe, extending 1,000 ft. into the lake, to a point 13 ft. below the the surface. The pipe is laid in a crib.

Engine House and Pump-Well.—A new engine house has recently been built with its walls and the engines foundations on solid rock. The well is 10 by 6 ft., by 18 ft. deep, half in rock, built up from bottom with 1 ft. of hard burned brick, laid in Portland cement, and with a heavy copper wire screen of ¼-in. mesh between the inlet and the suction pipe of the engine.

Pumping Machinery.—Combined dy. cap., 10,000,000 galls. Two 2,500,000-gall. Cornish Bull pumping engine with 60-in. steam cylinders, and 21-in. water plungers having a 10-ft. stroke; one 5,000,000-gall. horizontal compound Holly-Gaskill pumping engine.

Stand-Pipe.—Is 251 ft. high, enclosed in a masonry tower, whence a 20-in. cast-iron main leads to the reservoir.

Reservoir.—Cap., 30,000,000 galls.: in excavation and embankment, in two parts, slopes puddled, and lined with brick. It is about 2 miles from the pumping station, and its bottom is 210 ft. above the surface of the lake.

Distribution.—*Mains*, c. i., 56½ miles. *Services*, galv. i. *Taps*, 6,367. *Meters*, 76. *Hydrants*, Mathews, 318. *Valves*, Eddy.

Consumption, 3,335,190 gall. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $975,646. Debt, $675,000. Int., 7%. Ann. op. exp., $17,493. Ann. rev.: consumers, $67,122; city, none.

Management.—Three Commrs., one appointed each year by Court of Common Pleas of Erie Co. Prest., Geo. W. Starr. Secy. and Treas., B. F. Sloan. Supt. street work, Wm. O'Lone. Mech. Engr., F. A. Roth.

FOXBURGH, *Clarion Co.* (Pop., 514.)

History.—Built in '77 by Foxburgh Water-Works Co.

Water Supply.—Allegheny river, pumping to tanks.

Pumping Machinery.—Dy. cap., about 20,000 galls.

Tanks.—Two, cap. about 20,000 galls., each.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps and Meters*, not given. *Hydrants*, kind not given, 15.

Consumption, about 12,000 galls. *Pressure*: not given.

Financial.—Not given.

Management.—Address J. M. Fox, or Supt. Frank Dale.

FRACKVILLE, *Schuylkill Co.* (Pop., 1,807; est., 3,000.) Is 11 miles from Pottsville in mountainous coal and iron region. Settled in '61; incorp. a borough in '76.

History.—Built in '83 by Mountain City Water Co., under the direction of the present Secy., Jno. Haupt. An injunction was brought against the Co. several years ago by the borough of Ashland prohibiting the former from taking water from Little Mahanoy creek. Ashland has taken its supply from the same creek, 2 miles below, since '76, having bought ten acres of land on the stream. The land from which the above company took its supply has been owned by some of its members for 34 years. Ashland claims sole right to the water in the stream above, and their claim has been sustained by the Schuylkill County Court. The case has gone to the Supreme Court, and it is hoped a decision will be reached in Feb., '89. At present the works are not being operated.

Water Supply.—Little Mahanoy creek, pumping to reservoir. Creek has a drainage area of 5 sq. m.

Pumping Machinery.—Blake upright pump, dy. cap., 24,000 galls.

Reservoir.—Cap., about 500,000 galls.; is 100 ft. sq., 6 ft. deep, 150 ft. above pump, and 50 ft. above the average elevation of town.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 50. *Meters*, none.

Consumption, has been 10,000 galls. *Pressure*: Ordinary, 50 lbs.

Financial.—Cost, $20,000. No debt. No further financial data to give, as works are not in operation.

Management.—Prest. and Genl. Mgr., F. S. Haupt. Secy., J. Haupt.

FRANKLIN, *Venango Co.* (Pop., 5,010; est.,7,500.) On French creek, near Allegheny river. In oil and natural gas region. Incorp. a city in '68.

History.—Built in '78 by Venango Water Co. Des. Engr., H. P. M. Birkinbine, Philadelphia, deceased. Const, Engr., I. W. F. Sherwin. Work done by Co.

Water Supply.—Springs, by gravity, and French creek, by direct pumping. The water from springs is collected in a small reservoir, 162 ft. above city. There is an impounding reservoir on creek.

Impounding Reservoir.—Cap., 17,000,000 galls.; formed by dam across ravine. The dam is satisfactory, but water leaks through the broken rocky strata forming the hillside bordering the reservoir, and passes out some distance below the dam. In '88 steps are being taken to stop the leaks.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington compound duplex pump.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co,, Philadelphia. *Taps*, 1,200. *Meters*, none. *Hydrants*, Bailey, 50. *Valves*, Eddy.

Consumption, 800,000 galls. *Pressure*: 45 lbs. Fire, 60 lbs.

Financial.—Cost, $150,000. Capital stock, $100,000. Bonded debt, $46,000. Int., 5%. Ann. op. exp., $3,500. Ann. rev.: consumers, $12,000; city, $500.

Management.—Prest., F. W. Mitchell. Secy., H. W. Bostwick. Supt., R. J. Hanna.

FREELAND, *Luzerne Co.* (Pop., est., 3,000.) In wealthy and prosperous coal region, and has foundry, planing mill and machine shops.

History.—Built in '83 by Freeland Water Co.

Water Supply.—Artesian well, pumping to reservoir, and direct pumping.

Pumping Machinery.—Dy. cap., 300,000 galls.; two Worthington pumps, and 4 steel cylinder boilers.

Reservoir.—Is 63 by 83 ft., by 9 ft. deep.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 392. *Meters*, none. *Hydrants*, Tamaqua, 18. *Valves*, Mellert.

Consumption, 200,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 to 80 lbs.

Financial.—Cost, $21,000. Capital stock, $22,000. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $4,000; city, $210. Hydrant rental, $15.

Management.—Prest., Jos. Birkbeck. Treas., Thos. Birkbeck. Secy., F. Schilcher.

FREEPORT, *Armstrong Co.* (Pop., 1,614; est., 2,000.) On Allegheny river, 29 miles from Pittsburgh.

History.—Built for domestic supply in '83-4 by Freeport Water-Works Co. Engr., S. P. McRea, Freeport. The Co. did the work.

Water Supply.—Allegheny river, pumping to tanks.

Intake Crib.—Timber, 7 ft. sq. by 7 ft. high, covered with 2 in. plank and cross-covered with inch boards. This is sunk in the gravel bed of the river and covered with 18 in. of gravel, the water entering the bottom in a satisfactory manner.

Pumping Machinery.—Dy. cap., not given; the first pump was a Fort Pitt plunger of 12-in. steam and 6-in. water cylinder and 18-in. stroke, built by Wilson & Snyder. Later a Blake duplex pump was added.

Tanks.—Cap. not given; two of wood, 3,000 ft. from, and 200 ft. above center of town.

Distribution.—*Mains*, Kalamein w. i., 4 miles. *Services*, w. i. *Taps*, (in '84), 100. *Meters*, none.

Consumption, (in '84,) 12,000 galls. *Pressure*: Ordinary, 85 lbs.

Financial.—Cost, $12,600. No debt. Ann. op. exp., (in '84,) $900. Ann rev.: consumers, (in '84,) $1,000; city, none.

Management.—Prest., H. L. Weaver. Directors, Jno. Ralston, D. A. Cunningham, P. Spaugo, I. Gowin, G. M. Hill. Report made by the latter, who is also Town Clerk.

GETTYSBURGH, *Adams Co.* (Pop., 2,814; est., 3,300.)

History.—Built by Gettysburgh Water Co., date not given. Const. Engr., Geo. Harris, Hagerstown, Md.

Water Supply.—Driven well, 100 ft. deep, on East Cemetery hill, pumping to reservoir, 50 ft. distant.

Pumping Machinery.—Dy. cap., not given; pump is driven by a windmill.

Reservoir.—Cap., 90,000 galls.; about 25 ft. above pump.

Distribution.—(In '82.) *Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 4.

Consumption, about 60,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—No data given, save ann. rev. from consumers in '82, $1,000.

Management.—Prest., Chas. Horner. Secy. and Treas., J. W. Kendlehart.

GIRARDVILLE, *Schuylkill Co.* (Pop., 2,730; est., 3,000.) In coal region.

History.—Built in '81 by borough. Const. Engr., E. C. Wagner, Girardville.

Water Supply.—From a connection with the mains of the Girard estate, by gravity.

Distribution.—Not given, save that the system is extended through all streets, with hydrants at nearly every corner.

Consumption, about 6,000 galls. *Pressure*: 150 lbs.

Financial.—Cost, not given. Debt, $15,000. Int., 4%. Ann. op. exp., about $500. Water costs $50 for the first million galls., and $100 for each additional million. Ann. rev: consumers, not given.

Management.—Comm. Supt., Patrick O'Brien. Clerk and Town Council, W. G. Parker.

GREENSBURGH, *Westmoreland Co.* (Pop., 2,500; est., 5,000.) In agricultural, coal mining and natural gas district. Heated and lighted by natural gas, some of the largest wells in the country being three miles from town.

History.—Being built in '88 by Westmoreland Water Co. Engr., C. W. Knight, Rome, N. Y. Contr., Pennsylvania Pipe Mfg. Co., Germantown, Pa. It is proposed to supply Jeanet, Irwin, Penn and Grapewell.

Water Supply.—Streams on Chestnut Ridge, by gravity.

Financial.—Cost, est., $300,000.

Management.—Prest., Geo. F. Huff. Report made by Murray Forbes, Derry Station.

A full description will be found in the Supplement.

GREENVILLE, *Mercer Co.* (Pop., 3,007; est., 4,600.) On Shenango river, in farming and coal region. Has rolling mills and manufactories.

History.—Built in '85-7 by Greenville Water Co. Engr., C. W. Knight, Rome, N. Y. Contr. for masonry and buildings, S. R. Cochran, Greenville.

Water Supply.—Springs, by gravity from an elevation of 180 ft.

Reservoir.—Cap., 8,000,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia. *Taps* and *Meters*, not given. *Hydrants*, Mathews, 35. *Valves*, R. D. Wood & Co.'s.

Consumption, unknown. *Pressure*; Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $50,000. Capital stock, $84,000. Bonded debt, $42,000. Int., 6%. Ann. op. exp., $600. Ann. rev.: consumers, $2,295; city, $1,225. Hydrant rental, $35.

Management.—Prest., J. T. Blair. Treas., A. F. Henleim. Secy., P. E. McRae. Supt., S. R. Cochran.

HANOVER, *York Co.* (Pop., 2,317; est., 5,000.) In an elevated valley, in center of highly cultivated region.

History.—Built in '74 by Hanover Water Co. Des. Engr., Robert K. Martin, Baltimore.

Water Supply.—Mountain springs, by gravity from collecting reservoirs.

Reservoirs.—Combined cap., 4,000,000 galls.: one of 2,500,000, and one of 1,500.000 gall. cap., formed by dams across ravines, and are 175 ft. above town.

Distribution.—*Mains*, c. i., 6 miles. *Services*, c. i. *Taps*, 360. *Meters*, 5. *Hydrants*, Reading, 29. *Valves*, Ludlow.

Consumption, 40,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $38,325. Capital stock, $30,000. No debt. Ann. op. exp., $820. Ann. rev.: consumers, $3,500: city, $145. Hydrant rental, $5.

Management.—Prest. and Supt., Stephen Keefer. Secy., R. M. Wirt.

HARRISBURG, *Dauphin Co.* (Pop., 30,762: est., 40,000.) On Susquehanna river, mostly on plateau 26 to 50 ft. above river and extending back on the hills. Has large iron manufactories. Settled in 1726: incorp. a borough in 1791: a city in '60.

History.—Built in '44 by borough, and new works built in '72-4 by city. Engr. of the first works, F. Erdman; of present works, H. P. M. Birkinbine.

For the first works a 30-in. cast-iron pipe, laid to a point 108 ft. from the shore conducted water to the pump-well, from which it was pumped to a reservoir through an 8-in. cast-iron pipe, by a horizontal high-pressure crank and fly-wheel pumping engine of 12-in. steam cylinder, with pump of 8-in. bore, both of 5 ft. stroke. The reservoir was 150 ft. square by 16 ft., was 2,046 ft. from pump and 91.32 ft. from low water in river. In '60 a 2,000,000-gall. Worthington duplex pump was added, and a 16-in. force main laid. In '67-9 the daily consumption was 1,089,089 galls., and the works had cost $225,000. The new works, as built in '74 and extended since, are described below.

Water Supply.—Susquehanna river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Combined dy. cap., 12,000,000 galls. The two pumps put with the new works in '74 were made by the Harrisburg Car Co., and consisted of horizontal crank and fly-wheel engines, one non-condensing with 30 in. cylinder, the other condensing with 54-in. cylinder: one having a 22½ and the other a 19½-in. pump, both of 5-ft. stroke. They are arranged to work separately or as a compound engine. A Knowles pump has also been put in having 20-in. steam and 14-in. water cylinder, with 24-in. stroke.

Reservoir.—Cap., 20,000,000 galls.: is 230 ft. above pumps and connected with them by a 30-in. force main. In excavation and embankment, 444 by 525 ft. at top, 194 by 275 ft. at bottom, and 27 ft. deep. Contr., J. Criswell.

Stand-Pipe.—Is 5 ft. in diam. by 205 ft. high, enclosed in an ornamental brick tower. Contrs., Harrisburg Car Co.

Distribution.—*Mains*, c. i., about 30 miles. *Services*, lead. Pipe and specials furnished by J. W. Starr & Sons, Camden, N. J., and pipe laid by a Mr. Hicks. *Taps*, unknown; there were 6,000 in '85. *Meters*, Crown, 75. *Hydrants*, Ludlow, Mathews, about 500. *Valves*, Ludlow, Eddy.

Consumption, 6,400,000 galls. *Pressure*: 40 to 75 lbs., varying with elevation.

Financial.—Cost, about $700,000. Bonded debt, $449,000. Int., 6%. Bonds have been issued to the amount of $551,000, but over $100,000 have been redeemed. The above cost is based on the assumption that $150,000 in cash has been spent in construction. Ann. op. exp., $24,000. Ann. rev.: total, $70,000.

Management.—Commrs.: E. Mather, J. G. M. Bayard and Jas. D. Saltsman. Supt., Jno. H. Weitmyer.

HAZLETON, *Luzerne Co.* (Pop., 6,935; est., 14,500.) Engaged in coal mining, manufacturing hats and wagon springs, and is the centre of trade for 50,000 people within a radius of 15 miles.

History.—Built in '60 by Hazleton Water Co.

Water Supply.—Springs, by gravity from collecting reservoirs with pumping as auxiliary.

Reservoirs.—Combined cap., 25,000,000 galls.: five, all but one being on the south side of the town, about 70 ft. above it. The other is about two miles distant, over a ridge, and water is pumped from it only during dry summer months. It is unofficially reported that the supply depends altogether upon the rainfall, and that water is raised from reservoir to the top of the ridge, whence it flows into the other reservoirs.

Pumping Machinery.—Cap., 800,000 galls.; locomotive boiler and home-made pump.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. lead. *Taps*, 2,000. *Meters*, 6. *Hydrants*, Cassin, 26. *Valves*, Cassin.

Consumption, 500,000 galls. *Pressure*: Ordinary, 18 lbs. Fire, not given.

Financial.—Cost, $200,000. Capital stock, $200,000. No debt. Ann. op. exp., in '85, $3,580. Ann. rev.: consumers, withheld; city $350. Hydrant rental, $18.50.

Management.—Prest., E. P. Wilber. Secy. and Treas., T. M. Santee. Supt., D. Clark.

HOLLIDAYSBURGH, *Blair Co.* (Pop., 3,150; est., 5,000.) On Juniata river, at western foot of Alleghany Range. The chief industries are coal mining and iron manufacturing.

History.—Built in '67 by borough. Engr., Jno. Branley.

Water Supply.—Roaring run, by gravity, water being taken 3 miles from, and 279 ft. above, town.

Distribution.—*Mains*, c. i., 13 miles. The supply pipe and distributing mains were originally of Wyckoff wood, but have been changed to c. i. *Services*, w. i. *Taps*, 800. *Meters*, none. *Hydrants*, Ludlow, 45. *Valves*, Eddy. *Consumption*, 150,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $73,000. Debt, $10,000. Int., 4%. Ann. op. exp., about $230. Ann. rev.: consumers, $7,000; city, none.

Management.—Commrs.: Wm. R. Smith, Ed. R. Baldrige, W. G. Heust. Supt., C. A. McFarland.

HOLMESBURGH, *Philadelphia Co.* (Pop., est., 2,000.) A suburb and branch P. O. of Philadelphia. Has some manufactories.

History.—Built in '87-88 by Holmesburgh Water Co. Engr., Isaac S. Cassin, Philadelphia. Contr. for masonry and buildings, a Mr. Pyle, of Wilmington, Del.

Water Supply.—Sandy run, pumping to stand-pipe, probably from impounding reservoir.

Reservoir.—Cap., 1,500,000 galls.

Pumping Machinery.—Holly-Gaskill pump, dy. cap., 1,000,000 galls.

Stand Pipe.—Cap., 100,000 galls.; furnished by Harrisburg Stove & Boiler Works, of Harrisburg.

Distribution.—*Mains*, c. i., about 5 miles.

Financial.—Cost, $40,000. Capital stock, $30,000. No bonds.

Management.—Prest., Wm. B. Bunker. Secy., A. C. Shallcrass. Treas., J. Rowland.

Works not finished at time of report, hence its incompleteness.

HONESDALE, *Wayne Co.* (Pop., 2,620; est., 5,000.) On Lackawaxen creek. Has extensive coal trade, and silk and other manufacturing.

History.—Built in '70-1 by private company, name not given.

Water Supply.—Lake, 4 miles distant, by gravity.

Distribution.—(In '82.) *Mains*, c. i., 8 miles. *Services*, not given. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 8. *Pressure gauge*, Edson.

Consumption, 120,000 galls. *Pressure*: 50 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., (for '81,) $1,600. Ann. rev.: (for '81,) $3,000.

Management.—Supt., F. D. Thayer. Report made by E. C. Mumford.

HUMMELSTOWN, *Dauphin Co.* (Pop., 1,043; est., 1,600.) Is 9 miles from Harrisburg. Has planing mill, machine shop, foundry, terra cotta works, carriage factories, and quarries of brown sandstone.

History.—Built in '88 by Hummelstown Water Co., who own a flouring mill and run it in connection with the works. The charter is perpetual. Engrs. and Contrs., Raymond & Campbell, Middleton. Sub-Contr. for buildings, Geo. H. Grove, Hummelstown.

Water Supply.—Swatara creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., not given; Raymond & Campbell, Middleton. Run in connection with a flouring mill owned by the Co. Three hours a day of pumping furnishes all the water needed.

Stand-Pipe.—Is 109 ft. high and 6 ft. in diam.; furnished by Raymond & Campbell, Middleton.

Distribution.—*Mains*, kind not given, 2½ miles. *Services*, not given. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 22.

Consumption, not yet known. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $30,000. The flouring mills and water-works together cost $50,000, and the total capital stock of the Co. is $22,500; bonded debt, $22,500; additional debt, $5,000. Int., 6%. Ann. op. exp., not determined. Ann. rev.: consumers, $600; city, $600.

Management.—Prest., F. J. Schaffner. Secy., W. H. Siple. Treas., J. S. Strickler. Supt., Simon Campbell.

HUNTINGDON, *Huntingdon Co.* (Pop., 4,125; est., 5,000.) On Juniata river. Engaged in manufacturing and mining.

History.—Built in '85-6 by Huntingdon Water Co., Limited. The company is not incorporated but has a ten years' contract for fire hydrants. No Engr. Contr. for masonry and buildings, Z. Yenter, Huntingdon.

In '79 a water supply was introduced to the Penitentiary, probably by the State. Water from three springs is collected in a 96,000-gall. reservoir, and conveyed thence through 3,300 ft. of 8-in. pipe, having a fall of 26 ft. Contr., W. W. Morrison, Lock Haven. Cost, $5,450.

Water Supply.—Standing Stone creek, pumping to reservoir, and pumping direct.

Pumping Machinery.—Knowles compound condensing pump, dy. cap. not given.

Reservoir.—Cap., about 1,500,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials furnished by Gloucester Iron Works, Philadelphia. Trenching done by R. H. Hill, Williamsport, and pipe laid by J. Detmor. *Taps*, 300. *Meters*, 1. *Hydrants*, kind not given, 42.

Consumption, not given. *Pressure*: Ordinary, 180 lbs. Fire, 120 lbs.

Financial.—Cost, $60,000. Debt, $60,000. Int., 4%. Ann. op. exp., not given. Ann. rev.: consumers, est., $4,000; city, $1,680. Hydrant rental, $40 each for 40.

Management.—Supt., J. W. Berry. Report made by J. Murray Africa, City Engr.

JERMYN, *Lackawanna Co.* (Pop., 1,541: est., 2,500.)

History.—Built in '84 by Jermyn Water Co. Work done by the day under direction of F. S. Pecke.

Water Supply.—Aylesworth creek, by gravity.

Reservoir.—Is 150 ft. sq.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 250. *Meters*, none. *Hydrants*, Ludlow, 10. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Cost, $26,350. Capital stock, $26,350. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $3,700, of which $1,000 is from collieries and $550 from manufactories, city, $150. Hydrant rental, $10.

Management.—Prest., J. J. Jermyn. Supt. and Secy., W. S. Hutchings.

JERSEY SHORE, *Lycoming Co.* (Pop., 1,411: est., 2,000.) On Beach creek and West Branch Susquehanna river, 12 miles from Williamsport.

History.—Built in '85 by Jersey Shore Water Co. Engr., E. D. Trump, the present Supt.

Water Supply.—Springs and surface water, pumping to reservoir.

Pumping Machinery.—Cap., 1,000,000 galls.: compound condensing Knowles pump, and horizontal tubular boiler.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 88. *Meters*, none. *Hydrants*, Mathews, 31.

Consumption, 100,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $50,000. Capital stock, $55,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $600. Ann. rev.: consumers, $2,100; city, $1,330. Hydrant rental, $40 for first 25, $30 for additional.

Management.—Prest., Frank Trump. Supt. and Treas., E. D. Trump.

JOHNSTOWN, *Cambria Co.* (Pop., 8,380; est. pop. supplied, 30,000.) At foot of Alleghany mountains, on hilly ground on the Conemaugh river. Manufactures iron, steel, wire, cement, fire-brick, leather and woolen goods. Settled about 1800.

History.—Built in '67 by Johnstown Water Co. Water is furnished in Conemaugh to the railroads for manufacturing purposes, and a few residences.

Water Supply.—By gravity from Conemaugh and St. Clair rivers, Laurel run and Mill Creek, all mountain streams. An additional supply from Stony creek has been proposed. When completed it will consist of a 30-in. supply main, 5 miles long, leading to the city, but at first it will connect with the main from the Mill creek reservoir.

Reservoirs.—Est. cap. of five, 150,000,000 galls. The Laurel run reservoir has a cap. of 5,500,000 galls., and is formed by a clay dam 19 ft. high. It is 165 ft. above the city with which it is connected by 5 miles of 16-in. cast-iron pipe.

The St. Clair reservoir has a cap. of 25,000,000 galls., is formed by an earth dam, 20 ft. high, with puddle wall and riprap slope. It is 175 ft. above the city, and water is conveyed to a junction with the Laurel run main by 3 miles of 12-in. cast-iron pipe.

The Conemaugh reservoir has a cap. of 6,000,000 galls., and is formed by a dam 6 ft. high, of timber cribs, filled with stone, planked over. It is 2½ miles above Conemaugh, and about 5 miles from Johnstown, at an elevation of 154 ft. A 20-in. cast-iron pipe leads to the city. The Mill creek supply was introduced in '86 or '87. A description of the reservoir is not given, but it is connected with the city by 5⅜ miles of 20-in. pipe.

Distribution.—*Mains*, c. i., 45 miles. *Services*, lead. *Taps*, 2,550. *Meters*, none. *Hydrants*, Mathews, 100. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $479,400. Capital stock, $375,000. Outstanding bonds, $85,000. Int., 4%. Ann. op. exp., $4,500. Ann. rev.: consumers, $60,000. The city pays $500 for each new hydrant, which is a perpetual lease. Private parties pay a hydrant rental of $37.58.

Management.—Prest., Jas. McMillen. Supt., Jas. Williams. Report made by A. H. Walters.

KENNETT SQUARE, *Chester Co.* (Pop. 1,021; est., 1,500.) In agricultural region, 33 miles from Philadelphia. Has foundry and the works of the American Road Machine Co.

History.—Built in '42 by company, purchased by borough in '50, extended or rebuilt in '65, and being extended in '88, with Jno. Scott, Philadelphia, as Des., and J. McMullin, Kennett Square, as Const. Engrs.

Water Supply.—Surface water and spring, pumping to reservoir and standpipe.

Pumping Machinery.—Dy. cap., not given; made by E. T. Cope.

Reservoirs.—Cap., 38,000 galls.

Stand-Pipe.—Is 16 ft. in diam. and 30 ft. high.

Distribution.—*Mains*, c. i., 4.5 miles. *Services*, iron, lead. Pipe and specials for extensions in '88 furnished by R. D. Wood & Co., Philadelphia. *Taps* and *Meters*, not given. *Hydrants*, kind not given. 15.

Consumption, not given. *Pressure*: Ordinary, 5 to 40 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., about $200. Ann. rev.: not given.

Management.—Supt., E. P. Mercer.

KITTANING, *Armstrong Co.* (Pop., 2,624; est., 4,000.) On Allegheny river, in coal and iron region. Has manufactories.

History.—Built in '71 by Kittaning Water Co.

Water Supply.—Allegheny river, pumping to reservoir.

Pumping Machinery.—Keystone pump, dy. cap., not given.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 11 miles. *Taps*, not given. *Meters*, none. *Hydrants*, Mathews, 30. *Valves*, mostly Eddy.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Capital stock, $50,000. Bonded debt, $20,000. Int., not given. Ann.

op. exp., not given. Ann. rev.: consumers, not given; city, $650 for fire purposes. Hydrant rental, $21.66.

Management.—Prest., G. C. Orr. Supt., Secy. and Treas., W. B. Meredith.

KNOX, *Clarion Co.* (Pop., 1,020; est., same.)

History.—Built by borough, date not given.

Water Supply.—Wells, pumping to tanks.

Pumping Machinery.—Dy. cap., 8,125 galls.

Tanks.—Two: cap., about 20,000 and 8,000 galls., respectively.

Distribution.—*Mains*, c. i., ¾ miles. *Services*, not given. *Taps*, 20. *Meters*, not given. *Hydrants*, Ludlow, 6.

Consumption, about 6,000 galls. *Pressure*: 75 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., $100. Ann. rev.: not given.

Management.—Burgess and Borough Council.

LANCASTER, *Lancaster Co.* (Pop., 25,769; est., 32,000.) On Conestoga creek, on undulating ground rising 100 ft. above the stream. Has manufactories. Settled in 1718 as Hickory town, its name was changed to Lancaster in 1730; incorp. a borough in 1742; a city in '30.

History.—Built in '36 by borough. Engr., Frederick Erdman. In '87-8 the pumping station was moved further up the creek to obtain a supply uncontaminated with sewage, and other improvements made. Des. Engr., J. J. R. Croes, New York City. Const. Engr., S. M. Slaymaker. Contr. for buildings, Amos Urban, Lancaster.

Water Supply.—Conestoga creek, pumping to reservoir. For the old works a crib and stone dam formed a storage reservoir and furnished water-power for pumping.

Pumping Machinery.—Combined dy. cap., 9,000,000 galls.; 3,000,000 and 6,000,000-gall. Worthington pumps, and Babcock & Wilcox boilers. The first pumps were a double set of upright plunger pumps, 30-in. stroke, and three pumps in each set, driven by a water wheel. Later a horizontal Rush & Muhlenberg pump and a 500,000-gall. high-pressure Worthington steam pump were added.

Distributing Reservoirs.—Combined cap., 6,000,000 galls.; 200 ft. above, and 4,864 ft. from, pumps, in excavation and embankment. It is not stated whether the reservoir cap. has been enlarged since '82, when it was as above.

Stand Pipe.—Erected for high service supply, 5 ft. in diam. and 40 ft. high.

Distribution.—*Mains*, c. i., 32 miles. *Services*, w. i., lead. Pipe and specials for the new work furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and pipe laid by Davis Ritch & F. Hinden. *Taps*, 5,200. *Meters*, 10. *Hydrants*, Mathews, Galvin and an old style, 390.

Consumption, 4,000,000 galls. *Pressure*: Ordinary, 28 lbs.

Financial.—Cost, est., $600,000. Debt, $300,000. Int., 4, 5 and 6%. Ann. op. exp., $11,500. Ann. rev.: consumers, about $50,000; city, none.

Management.—Comm. of three, one from each branch of City Council. Chairman, the Mayor, W. A. Morton. Supt., J. Halback.

LANGHORNE, *Bucks Co.* (Pop., 558; est., 1,250.) In farming district.

History.—Built in '86-7 by Langhorne Spring Water Co. Engr., J. J. DeKinder, Philadelphia. Contr. for masonry, Thos. Gannon.

Water Supply.—Springs, collected in enclosing reservoir, pumping to tank. The reservor is 30 ft. square and 20 ft. deep.

Pumping Machinery.—Hall pump, dy. cap., 300,000.

Tank.—Cap., 40,000 galls.; on stone tower.

Distribution.—*Mains*, c. i., about 7 miles. *Services*, galv. i. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J. *Taps*, 129. *Meters*, not given. *Hydrants*, Cassin, 9.

Consumption, 35,000 galls. *Pressure*: said to be 200 lbs.

Financial.—Cost, about $25,000. The cost includes the price paid for 38 acres of land about the springs. Capital stock, authorized, $40,000, of which but $30,000 has been issued. No debt. Ann. op. exp., $900. Ann. rev.: consumers, $1,500; city, none.

Management.—Prest., Chas. Hill. Treas., F. P. Wight. Supt. and Secy., Saml. C. Eastman.

LANSDALE, *Montgomery Co.* (Pop., 798; est., 1,500.) Is 22 miles from Philadelphia. Has manufactories and is a trade center.

History.—Now owned by borough; built in '72 by private company.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Not given.

Tank.—Not given.

Distribution.—(In '84.) *Mains*, c. i., 1 mile. *Services*, l ad. *Taps*, 35. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—(In '84.) Cost, $15,800. Debt, $5,000. Int., 5%. Ann. op. exp., not given Ann. rev.: consumers, not given; city, none.

Management.—Supt., W. D. Heebner.

LANSFORD, *Carbon Co.* (Pop., 2,206; est., 3,000.) On Panther creek, on irregular ground in a valley of the Lehigh mountains, the ranges at this point being 400 to 500 ft. high and about a mile apart. Settled in '47; incorp. a borough in '77.

History.—Built in '73 by Panther Creek Water Co. Engr., J. C. Rutter.

Water Supply.—Streams on Broad mountain, about 3 miles distant, by gravity from impounding reservoir.

Impounding Reservoir.—Cap., 500,000 galls.; is 200 ft. above town, covers 2 acres and is formed by a dam across stream.

Distribution.—(In '84.) *Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 210. *Meters*, 0. *Hydrants*, kind not given, 3.

Consumption, not given. *Pressure*; Ordinary, 112 lbs. Fire, 112 lbs.

Financial.—(In '84.) Cost, $52,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $3,000; city, none.

Management.—Supt., W. D. Zehner.

LATROBE, *Westmoreland Co.* (Pop., 1,815; est., 4,500.) In agricultural, coal mining and coke burning region, 41 miles from Pittsburgh.

History.—Built in '86 by Latrobe Water Co. Engr., J. H. Harlow, Pittsburgh. Contrs., Gas & Water-Works Construction Co., Pittsburgh.

Water Supply.—Loyalhanna river, filtered to a well, thence by direct pumping.

Pumping Machinery.—Cap., 2,600,000 galls.; two duplex 1,300,000 gall. pumps made by Wilson, Snyder & Co.

Distribution.—Being rapidly extended. *Mains*, c. i., 4 miles. *Services*, not given. Pipe and specials furnished by R. D. Wood &Co., Philadelphia,and National Foundry & Pipe Works, Limited, Scottdale. *Taps*, 110. *Meters*, none. *Hydrants*, Mathews, 23. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure*; Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Capital stock, $150,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $4,000; city, $1,120. Hydrant rental, $50 for first 20,$40, for second 20, and $30 for next 20, a ten year's contract.

Management.—Prest., H. L. Donnelly. Treas., J. C. Head. Supt. and Secy., W. A. Johnston.

LEBANON, *Lebanon Co.* (Pop., 8,778; est., 13,000.) On Quittapahilla creek on slightly undulating ground in the Lebanon valley, between the Blue Ridge and the Kittatinny mountains. Has large iron works. Settled in 1750; incorp. a borough in '13.

History.—Built in '72 by borough. Des. Engr., H. P. M. Birkinbine. Const. Engr., Benj. Lehman and Simeon Guilford.

Water Supply—Springs, by gravity from impounding reservoirs.

Impounding Reservoirs.—Combined cap., 38,000,000 galls.; one of 20,000,000 and one of 18,000,000 galls. The former is 6 miles from, and 80 ft. above, the town, in the Kittatinny mountains, and is formed by a dam 30 ft. high across a ravine. Above the main dam a gravel "catch dam" was built to filter the water before it entered the 16-in. main leading to town. No description of the other reservoir has been given.

Distribution.—*Mains*, c. i., 22 miles. *Services*, galv. i., lead. *Taps*, 1,762. *Meters*, 21. *Hydrants*, Morris, Tasker & Co's.; and lately, Ludlow and Eddy, 98. *Valves*, kind, do.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $252,000. Debt, $160,000. Int., 4 and 5%. Ann. op. exp., $1,200, Ann. rev.: consumers, about $13,000.; city, none.

Management.—Supt., R. J. Shirk.

NOTE:—A report on a proposed new water supply has been made by A. Harvey Tyson, Reading, and accepted by the Water Committee. The report advises that a supply be taken from the Swatara creek, at Jonestown, by pumping to stand pipe. The estimated cost of the improvements is $200,000.

LEWISBURGH, *Union Co.* (Pop., 3,080; est., 4,000.) On west branch of Susquehanna river, on nearly level ground. Settled in 1785; is incorp. a borough.

History.—Built in '83 by Lewisburgh Water Co., under the direction of the present Supt., S. D. Bates.

Water Supply.—West branch of Susquehanna river, pumping to standpipe.

Dam.—Across river, 4 ft. high, giving a depth at low water of 7 ft. above suction pipe, which extends 550 ft. into the stream.

Pumping Machinery.—Dy. cap., 1,500,000 galls.: Knowles compound duplex pump, with 16 and 10-in. steam, and 10-in. water cylinders, and 12-in. stroke, lifting water 140 ft.

Stand-Pipe.—Is 12 ft. in diam. and 130 ft. high.

Distribution.—*Mains*, c. i., 4.7 miles. *Services*, w. i., galv. i. *Taps*, 236. *Meters*, 3. *Hydrants*, Ludlow, 45. *Valves*, Ludlow.

Consumption, 120,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $37,577. Capital stock, $32,000. Bonded debt, $4,000. Int., 5%. Ann. op. exp., $1,713. Ann. rev.: consumers, $2,696; city, $1,350. Hydrant rental, $30 each for 45; a five years' contract.

Management.—Prest., W. C. Duncan. Secy., G. S. Matlock. Treas., A. Hayes. Supt., S. D. Bates.

LEWISTON, *Mifflin Co.* (Pop., 3,222; est., 3,500.) On Juniata river Has manufactories.

History.—Built between '50 and '60, exact date not given, by Lewiston Water-Works Co.

Water Supply—Springs, by gravity, with pumping station about one mile from village, on Keshacoquiltses creek. Boring for water in '88.

Pumping Machinery.—Not given.

Distribution.—*Mains*, c. i., length not given. *Services*, lead, iron. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption and *Pressure*, not given.

Financial.—No data given.

Management.—Prest., R. H. Lee. Secy., Gen. F. F. McCoy.

LITITZ, *Lancaster Co.* (Pop., est., 2,000.) Mainly engaged in mechanical pursuits.

General Description.—A small system used only for street sprinkling, built by a chartered company, name and date not given. Water pumped from Lititz springs to an iron tank of 9,375 galls. cap. Pump has dy. cap. of about 10,000 galls. Prest., Isaac F. Bomowger. Treas., Martin Miller. Secy., Johnson Miller.

LOCK HAVEN, *Clinton Co.* (Pop., 5,845; est., 7,500.) On west branch of Susquehanna river. Engaged in manufacturing and lumber trade. Settled in '33; incorp. a city in '70.

History.—Built in '69 by town. Des. Engr., Phaon Jarett. Const. Engr., A. J. Bigony. Contrs., George Armstrong and Lambert Shield & Co.

Water Supply.—Two mountain streams, by gravity from impounding reservoirs on each. The streams have a combined drainage area of 15 sq. m.

Reservoirs.—Cap., 6,000,000 galls.; two 183 ft. above city, formed by dams.

Distribution.—*Mains*, c. i., 14 miles. The first mains were w. i. and cement, but they were a failure. *Services*, galv. i. In '81 lightning struck a house, followed the service pipe to a 4-in. main, and destroyed 400 ft. of the latter. *Taps*, 750. *Meters*, none. *Hydrants*, kind not given, 80.

Consumption not given. *Pressure*: Ordinary, 77 lbs. Fire, 77 lbs.

Financial.—Cost, in '82, $130,000. Bonded debt, $114,000; bonds have been issued to the amount of $123,000, of which $9,000 have been redeemed. Ann. op. exp., $1,400. Ann rev.: consumers, $9,000; city, none.

Management.—Comm. of three from City Council. Supt., Jno. F. Griffin. Report made by L. M. Morrison.

LYKENS, *Dauphin Co.* (Pop., 2,154; est., 2,800.) In coal region, and furnishes supplies for same.

History.—Built in '85 by Lykens Water Co. Also supplies Wiconisco, which has a pop. of 1,800.

Water Supply.—Rattling creek, by gravity.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 414. *Meters*, none. *Hydrants*, Ludlow, 26. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Capital stock, $35,000. No debt. No further financial data given.

Management.—Prest., I. J. Wistar. Secy., Horace Whiteman, 233 South 4th St., Philadelphia. Supt., J. M. Williams.

McKEESPORT, *Allegheny Co.* (Pop., 8,212; est., 17,000.) At junction of Monongahela and Youghiogheny rivers, 752 ft. above the sea, on hilly ground rising to a height of 300 ft. above the rivers. Manufactures steel, wrought-iron pipe, sheet iron, and is center of coal, lumber and wrought-iron pipe trade. Settled in 1795; incorp. a borough in '42, and its limits were extended '47 and '73.

History.—Built in '81-2 by borough. Engrs., Hatch & Taylor, McKeesport. Contrs., R. D. Wood & Co., Philadelphia.

Water Supply.—Youghiogheny river, pumping to reservoir. A well was dug on the bank of the river, 28 ft. in diam. and 32 ft. deep, in the bottom of which 36 cast-iron perforated 4-in. pipes are driven 10 ft. into the saturated gravel. A 20-in. cast-iron pipe connected the well with the engine house.

Pumping Machinery.—Dy. cap., 3,000,000 galls. A 5,000,000-gall. pump being added, in '88. The pumps erected in '81-2 were two 1,500,000-gall. Worthington duplex high-pressure pumps. Natural gas is used for a fuel. A 1-in. pipe leads from the surface of the reservoir to the engine-house. When the reservoir is full water flows through the pipe, and by an automatic arrangement blows a steam whistle as a signal to stop pumps.

Force Main.—To reservoir, 1,547 ft. of 16-in. pipe, rising 310 ft. from river.

Reservoir.—Cap., about 6,000,000 galls; in excavation and embankment, 210 ft. sq. by 20 ft. deep to water line. Bottom is covered with 6 in. of concrete on 12-in. of puddle, and the slopes with 10-in. of stone blocks, laid in cement on 8-in. of broken stone, the latter being on 12 in. of puddle.

Distribution.—*Mains*, c. i., 17.5 miles. *Services*, lead. *Taps*, 1,535. *Meters*, 120. *Hydrants*, Mathews, 130.

Consumption, 1,100,000 galls. *Pressure*: Ordinary, 115 lbs. Fire, 115 lbs.

Financial.—Cost, $160,000. Bonded debt, $102,000. Int., 5%. Ann. op. exp., $4,500. Ann. rev.: consumers, $18,778; city, none.

Management.—Comm. of three. Supt., Jas. Escoff.

MAHANOY CITY, *Schuylkill Co.* (Pop., 7,181; est., 11,000.) On Mahanoy creek, at its junction with another small stream, in a mountainous region. Has potteries and iron foundries, and handles coal. Settled in '60; incorp. in '61.

History.—Built in '68 by Mahanoy City Water Co., under the direction of E. S. Silliman, the present Supt.

Water Supply.—Springs, and a stream on the Mahanoy mountain having a drainage area of 5 sq. m., by gravity from impounding reservoirs.

Impounding Reservoirs.—Four, formed by dams and covering 40 acres. The first one built was 1¾ miles from, and 350 ft. above the city, to which water was conveyed by a 10-in. cast-iron pipe.

Dam.—Of first reservoir, 700 ft. long and 22 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, c. i. *Taps*, 1,350. *Meters*, none. *Hydrants*, Snell & Adams, 23.

Consumption, 350,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 65 lbs.

Financial.—Cost, $100,000. Capital stock, about $100,000. Debt, $3,000. Int., 6%. Ann. op. exp., $2,865. Ann. rev.; consumers, $12,000; city, $100. Hydrant rental, nominal.

Management.—Prest. and Supt., E. S. Silliman. Secy., Henry Parmley. Asst. Supt., E. Silliman, Jr.

MANHEIM, *Lancaster Co.* (Pop., 1,666; est., 2,300.) In farming and iron mining region, and manufactures cigars.

History.—Built in '85 by Manheim Water Co. Engr. and Contr. for works complete, A. Harvey Tyson, Reading. Sub. Contrs. for masonry, L. Barthold & Co.; for wood-work of buildings, Graeeff, Reading.

Water Supply.—Lehman's creek, fed by springs, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., 600,000 galls.

Reservoir.—Cap., 800,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i., black i. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading. Trenching done by Maginnis & White, Manheim, and pipe laid by Mengel, Reading. *Taps*, 100. *Meters*, none. *Hydrants*, Tamaqua Mfg. Co.'s, number not given. *Valves*, Mellert & Co.'s.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $27,000. Capital stock, $28,000. No debt. Ann. op. exp., $816. Ann. rev.: consumers, $1,525; city, $600. Hydrant rental, not given.

Management.—Prest., A. Kline. Secy., B. H. Hershey. Treas., Geo. H. Danner.

MAUCH CHUNK and EAST MAUCH CHUNK, *Carbon Co.* (Pop., Mauch Chunk, 3,752; est., 5,000. East Mauch Chunk, 1,853.) The two boroughs are on steep hills, on opposite sides of the Lehigh river. A center of coal trade.

History.—Built in '49 by Mauch Chunk Water Co. In '61 a domestic supply was introduced in East Mauch Chunk. There is a system in each town, but data is not given separately except for the water supply. Engr. of original works, E. A. Douglas.

Water Supply.—Springs, by gravity from small impounding reservoirs, two for each town. The works built in '49 took a supply from springs, through 4,500 ft. of 3-in wooden pipe, to a small reservoir 143 ft. above, and 4,500 ft. from center of town. In '55 additional springs were collected in a reservoir and a 6-in. cast-iron pipe substituted for the wooden one. The supply for East Mauch Chunk in '61 was from a stream one mile from, and 80 ft. above town.

Impounding Reservoirs.—No further description furnished.

Distribution.—*Mains*, c. i., 4 miles. *Services*, lead. *Taps*, 500. *Meters*, 4. *Hydrants*, Mathews, 25, in Mauch Chunk. *Valves*, Ross.

Consumption, unknown. *Pressure*: 80 lbs.

Financial.—Cost, $37,500. Capital stock, $37,500. No debt. Ann. op. exp., $1,000. Ann. rev.: consumers, $5,000; city, none. Hydrant rental, free.

Management.—Prest., Robt. Klotz. Secy., S. S. Smith. Treas., C. O. S. Keer. No Supt.

MEADVILLE, *Crawford Co.* (Pop., 8,860; est., 10,000.) On French creek, chiefly in a valley, about one-third being on rising ground. Has flouring, silk and nail mills, glass factories, tanneries, machine shops and iron foundries. Settled in 1788; incorp. a borough in '23; a city in '65.

History.—Built in '74-5 by Meadville Water Co. Engs., Robt. Cartwright.

Water Supply.—French creek, pumping to reservoir.

Pump-Well.—35 ft. in diam., its bottom being on a level with deepest part of creek. It has dry stone walls, is 24 ft from the river and connected with it by a gravel filled trench, which acts as a filter. The gravel is renewed once in 4 years.

Pumping Machinery.—Cap., 5,000,000 galls.: Knowles and W. H. Lang water-power pumps. The Lang pump has two 12½ water cylinders, a 30-in. stroke, and a dy. cap. of 1,500,000 galls. It was erected in '80. The first pump erected was Flander's with two 11-in. cylinders having a 16-in. stroke, and was driven by an American turbine under a head of 15 ft., giving 109 H. P. The Knowles pump was added in '81.

Force Main.—Rises 285 ft.; 4,400 ft. of 12-in. cast-iron.

Reservoir.—Cap., 5,000,000 galls.; on slightly sloping surface, in excavation and embankment, 285 by 150 ft. at top, by 24 ft. deep, and has a division wall 10 ft. high Banks are 9 ft. wide on top with slopes 1¾ to 1. Bottom and inner slopes have 12 in. of puddle over which is 1 in. of gravel and a brick paving grouted with cement.

Distribution.—*Mains*, c. i., 17½ miles. *Services*, galv. i., enam. i. *Taps*, 1,150. *Meters*, 40. *Hydrants*, Mathews, 105. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 115 lbs. Fire, 115 lbs.

Financial—Cost, $170,000. Capital stock, $150,000. No bonds. Debt, $7,000. Int., 5%

Ann. op. exp., $7,000. Ann. rev.: consumers, $16,000; city, $5,250. Hydrant rental, $50, a ten years contract.

Management.—Prest., J. D. Gill. Secy., E. Hindekoper. Supt., Geo. S. Cullum.

MECHANICSBURGH, *Cumberland Co.* (Pop., 3,018; est., 4,000.) Is 8 miles from Harrisburg, in a broken agricultural district, having deposits of iron ore. Incorp. a borough in '26.

History.—Built in '57-8 by Mechanicsburgh Gas & Water Co. Engrs. and Contrs., Irish & Quinn.

Water Supply.—Springs, by gravity from collecting reservoirs. One spring is in limestone, the others in slate.

Collecting Reservoirs.—One 200 by 85 ft., by 10 ft. deep, and one 290 by 85 ft., by 4 ft. deep. The first reservoir receives water from springs collected by 1½ miles of tile pipe. At the outlet of this reservoir water passes through 5 sheets of galvanized iron, 2 by 4 ft., perforated with ⅛-in. holes, the sheets being set 15 in. apart in a wooden trough. From these strainers it passes for 700 ft. through a tunnel in the slate rock 3 ft. wide and 6 ft. high, and then through 600 ft. of 6-in. cast-iron pipe, fitted with a strainer, to the second reservoir. This reservoir is formed by a dam across a ravine and its sides are lined with walls of small stones laid dry to admit water from the adjoining soil, which is full of springs.

Supply Main.—Is 2½ miles long, and has a fall of 76 ft. At first it was a 6-in. pipe, but 1,000 ft. has been replaced by 10-in.

Distribution.—*Mains*, c. i., about 4 miles. *Services*, galv. i. *Taps*, 520 *Meters*, none. *Hydrants*, kind not given, 26.

Consumption, 12,000 galls. *Pressure*: 32 lbs.

Financial—Cost, $50,000. Debt, $18,000. Int., 5%. Ann. op. exp., $800. Ann rev.: consumers, $3,600; city, $400.

Management.—Prest., Jos. Lear. Treas., J. C. Bauman. Supt., Andrew Seifert, who has been connected with the work for 20 years.

MEDIA, *Delaware Co.* (Pop., 1,919; est., 3,000.) Is 12 miles from Philadelphia.

History.—Built in '71 by Borough. Engr., Isaac S. Cassin, Philadelphia. Work done by the day under direction of the borough officers.

Water Supply.—Ridley creek, pumping to reservoir.

Pumping Machinery.—Combined dy. cap., 1,400,000 galls; a 1,000,000-gall. Worthington water-power pump, driven by two Leffel turbines, and a 400,000-gall. Knowles steam pump.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—*Mains*, c., i. 6.6 miles. *Services*, lead. Pipe and specials furnished by Mellert Foundry and Machine Co., Reading. *Taps*, about 400. *Meters*, none. *Hydrants*, about 75: furnished by Union Hydraulic Co., and R. D. Wood & Co., Philadelphia. *Valves*, kind, do.

Consumption, 150,000 galls.

Financial.—Cost about $80,000. Debt, (in' 82,) $65,000. Int., 4%. Ann. op. exp., $1,000. Ann. rev.: consumers, $5,500; city, none.

Management.—Borough Council. Supt., Ralph Buckley.

MERCER, *Mercer Co.* (Pop., 2,344: est., 2,500.) On Neshannock creek, in agricultural, grazing and mining region. Has iron manufactories.

History.—Built in '87 by Mercer Water Co., under a ten year's franchise. Des. Engr. and Contr., Jas. H. Harlow, Pittsburgh. Conts. Engr., C. D. Barstow.

Water Supply.—Otter creek, filtered, by pumping to tank, with direct pumping in case of fire. The supply is taken about 2 miles below the source of the creek.

Filter and Pump-Well.—Water passes through a filter to a pump-well sunk 8 ft. in the gravel near the stream.

Pumping Machiney.—Dy. cap., 600,000 galls.; Smith-Vaile duplex pump, and 50 H. P. boiler.

Force Main.—Is of 6-in. cast-iron, one mile long, and rises 200 ft.

Tank.—Iron, 24 ft. in diam. and 20 ft. high, on an iron trestle 60 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 180. *Meters*, none. *Hydrants*, Ludlow, 24.

Consumption, 250,000 galls. *Pressure*: Ordinary., 40 lbs. Fire, 125 lbs.

Financial.—Cost, $20,000. Capital stock, $12,000. Bonded debt, $12,000. Int.,

6%. Ann. op. exp., $900. Ann. rev.: consumers, $1,340; city, $840 Hydrant rental, $35.

Management.—Prest., S. H. Miller. Secy., Jno. Robinson. Supt., not given.

MESHOPPEN, *Wyoming Co.* (Pop., 554; est., 800.)

History.—Built in '73 by Meshoppen Borough Water Co.

Water Supply.—Springs and brook, by gravity.

Reservoirs.—One 30 ft. sq. and 8 ft. deep, one 12 by 20 ft. and 5 ft. deep.

Distribution.—*Mains*, iron, 3 miles. *Services*, iron. *Taps*, 100. *Meters*, none. *Hydrants*, from Pancoast & Maule, Philadelphia, 2.

Consumption, 5,000 galls. *Pressure*: about 100 ft. head.

Financial.—Cost, $10,000. Capital stock, $4,000. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $600; city, none.

Management.—Prest., E. H. Wells. Secy., N. A. Wells. Treas., A. H. Sterling.

MEYERSDALE, *Somerset Co.* (Pop., 1,423; est., 1,700.) Has manufacturing, mining and lumber interests.

History.—Built in '88 by Sand Spring Water Co. Engr., G. L. Benford. Contr, J. S. Graves, Meyersdale. Sub., Contr., for masonry, Jno. Porter.

Water Supply.—Sand Spring, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, 20.

Consumption, not determined. *Pressure*: Ordinary, 110 lbs. Fire 110 lbs.

Financial.—Cost, $16,000. Capital stock, $10,500. Debt, $5,500. Int., 5%. No bonds. Ann. op. exp., est, $300. Ann. rev.; consumers, $1,000; city 600. Hydrant rental, $30.

Management.—Prest., S. Chamberlain. Secy., S. B. Philson. Treas., W. B. Cook. Report made by L. A. Smith.

MIDDLETOWN, *Dauphin Co.* (Pop., 3,351; est., 5,500.) On Susquehanna river, 9 miles from Harrisburg. Has manufacturing and lumber industries.

History.—Built in '85 by Middletown Water Co. No Engr. employed. Genl. Contr., M. Mahony, Middletown, who sublet masonry and buildings to local parties.

Water Supply.—Swatara creek, pumping to stand-pipe.

Pumping Machinery.—Cap., 23,000 galls.; a water-power pump made by Raymond & Campbell, Middletown.

Stand Pipe.—Is 16 ft. in diam. by 140 ft. high; made by Raymond & Campbell, Middletown.

Distribution.—*Mains*, c. i., nearly 4 miles. *Services*, not given. Pipe and specials furnished by R. D. Wood & Co., Philadelphia. *Taps*, 190. *Meters*, 2. *Hydrants*, Mathews, 35.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, $45,000. Capital stock, $50,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., about $2,500. Ann. rev.; consumers, $2,500; city, $1,549.50. Hydrant rental; $50.

Management.—Prest., Jos. Campbell. Treas., C. W. Raymond. No Supt.

MILFORD, *Pike Co.* (Pop., 983; est., 1,000.) On Delaware river, about midway between New York City and Philadelphia. A summer resort.

History.—Built in '66 by Milford Water Co., under a perpetual charter.

Water Supply.—Spring, by gravity.

Distribution.—*Mains*, iron, 4 miles. *Services*, iron, lead. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 61.

Consumption, not given. *Pressure*: 65 lbs.

Financial.—Cost, $15,000. Capital stock, $12,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $1,000; city, none.

Management.—Prest., J. C. Wallace. Treas., J. H. Van Etten. Supt., Milton Armstrong.

MILLERSTOWN, *Barnhart's Mills P. O., Butler Co.* (Pop., 1,108; est., 2,000.) In coal and oil region. Has machine and boiler shops.

History.—Built in '74 and owned jointly by borough and H. A. Leopold, the latter owning one mile of pipe and having use of water free, presumably for manufacturing purposes, for making repairs.

Water Supply.—Artesian well, pumping to tanks,

Pumping Machinery.—Dy. cap., 70,000 galls.; kind not given.

Tanks.—Two for village, combined cap., 28,000. In addition, H. A. Leopold has tanks with cap. of 64,000 galls.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, 40,000 galls. *Pressure*: Ordinary, 10 to 80 lbs. Fire, 30 to 90 lbs.

Financial.—Cost, not given. Debt, $500. Int., 6%. Ann. op. exp., $1.000. Ann. rev.: consumers, $1,500; city, $600.

Management.—H. A. Leopold & Son.

MILTON, *Northumberland Co.* (Pop., 2,102: est., 5,500.) On west branch of Susquehanna river. Manufactures iron and steel, cars, nails, axles, and hoops. Settled in 1790; incorp. a borough in '14.

History.—Built in '83 by Milton Water Co. Engr., Geo. H. Pierson.

Water Supply.—West branch of Susquehanna river, pumping to reservoir.

Pumping Machinery.—Worthington pumps, dy. cap., 3,500,000 galls.

Reservoir.—Cap., 2,000,000 galls.; excavated in red sandstone, lined with stone paving on clay puddle, 286 by 100 ft.

Distribution.—*Mains*. c. i., 7 miles. *Services*, galv. i. *Taps*, 350. *Meters*, none, *Hydrants*, Bailey, 41. *Valves*, Eddy.

Consumption, 300,000 galls. *Pressure*; Ordinary, 58 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Capital stock issued, $42,000. Bonded debt, $6,000. Int., 5%. Ann. op. exp., $2,850. Ann. rev.: consumers, $5,000. city, $1,080. Hydrant rental, $1,000 for first 37, or about $27 each; $20 for each additional. Contract for 5 years expires Nov., '89.

Management.—Prest. and Supt., R. F. Wilson. Secy. and Treas., H. R. Frick.

MINERSVILLE, *Schuylkill Co.*, (Pop., 3,249; est., 4,000.) Is 4 miles from Pottsville, and is engaged in coal mining.

History.—Built in '57-61 by Minersville Water Co. Const. Engr., Saml. Lewis. Contrs., Millen & Burket.

Water Supply.—Mountain springs, by gravity.

Distribution.—*Mains*, c. i., 9 miles. *Services*, lead. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 30. *Valves*, Eddy.

Consumption, 115,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $41,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers $6,000; city, none, hydrant rental being free.

Management.—Prest., Seth W. Geer. Treas., J. S. Lawrence. Secy., Chas. R. Kear.

MONONGAHELA CITY, *Washington Co.* (Pop., 2,904; est., 4,000.) On Monongahela river, 31 miles south of Pittsburgh. Engaged in mining and manufacturing and has oil and natural gas deposits.

History.—Begun in summer of '88 by Monongahela City Water Co., which is controlled by the Kittaning Consolidated Water Co.'s., of Kittaning. To be finished July 1,'88. Engr., Robt. F. Wilson.

Water Supply.—Monongahela river, pumping to reservoir.

Pumping Machinery.—Not purchased at time of report.

Reservoir.—Not described in report.

Distribution.—(Will be.) *Mains*, c. i., 15 miles. *Service*, not given. Pipe and specials furnished by National Pipe & Foundry Co., Scottdale. *Taps* and *Meters*, not decided. *Hydrants*, 20.

Consumption, not determined. *Pressure*: Ordinary, 70 lbs. Fire, 90 lbs.

Financial.—Cost, est., $140,000. Capital stock, $130,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., est., $1,500. Ann. rev.: consumers, not determined; city, $1,000. Hydrant rental, $50 each for 20, a ten year's contract.

Management.—Prest., V. Neubert. Treas., Wm. Pollock. Secy., Geo. H. Fox, Kittaning.

MOUNT CARMEL, *Northumberland Co.* (Pop., 2,378; est., 4,500.) Has extensive anthracite coal collieries.

History.—Built in '85 by Mount Carmel Water Co. Des. Engr., A. B. Cochran.

Water Supply.—Springs, by gravity.

eservoirs.—Two, combined cap., 5,000,000 galls.

Distribution.—*Mains*, kind not given, 5 miles. *Services*, not given. *Taps*, 500 *Hydrants*, kind not given, 24.

Consumption, 50,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $85,000. Capital stock, $25,000. Bonded debt, $5,000. Total debt, $5,625. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, $4,400; city, $240. Hydrant rental, not given.

Management.—Prest., Wm. Schwenk. Treas., L. W. Johnson. Supt., T. Scott.

MOUNT JOY, *Lancaster Co.* (Pop., 2,058; est., 2,200.) Is 12 miles west of Lancaster and 24 east of Harrisburg. Has iron foundry, and manufactures woolen goods and agricultural implements.

History.—Built in '74 by town. Engr., H. P. M. Birkinbine, Philadelphia, deceased.

Water Supply.—Chiquesalunga creek, pumping to reservoir, and direct pumping for fire protection.

Pumping Machinery.—Birkinbine and Weiner pump, dy. cap., not given.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 3.4 miles. *Services*, galv. i., black i. *Taps*, 261. *Meters*, none. *Hydrants*, made by P. Werner, Lebanon, 28.

Consumption, unknown. *Pressure*: Ordinary, 34 lbs. Fire, 45 lbs.

Financial.—Cost, $50,000. Bonded debt, $40,000. Int., 4%. Ann. op. exp., $600. Ann. rev.: consumers, $2,600; city, none.

Management.—Town Council. Supt., Willliam Kuhn.

NAZARETH, *Northamption Co.* (Pop., 984; est., 1,000)

History.—Built by Nazareth Water Co., date not given.

Water Supply.—Springs, by gravity and pumping to reservoir.

Pumping Machinery.—Dy. cap., about 125,000 galls.; one Deane steam, and one Gould wind-mill pump.

Reservoir.—24 by 120 ft., by 9 ft. deep.

Distribution.—*Mains*, 4-in. miles, c. i., 2 miles. *Services*, ¾-in., kind not given. *Taps*, about 100. *Meters*, none. *Hydrants*, mostly McKean, 16.

Consumption, 10,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost., $15,000. Capital stock, about $7,300. Total debt, $17,200, of which about $3,000 is bonds. Int., 5%. Ann. op. exp., $300. Ann. rev.: consumers, $625; city, $240. Hydrant rental, $15.

Management.—Prest., Saml. Odenwelder. Secy. and Treas., Frank Kunkle. Supt., John F. Bardell.

NEW BETHLEHEM, *Clarion Co.* (Pop., 773; est., 1,100.) On Red Bank creek, in rough hilly country. Engaged in coal and lumber business. Incorp. a borough in '52.

History.—Built in '83 by Citizens' Water Co. No Engr. employed, or general contract let. Buildings erected by C. E. Andrews & Son.

Water Supply.—Red Bank creek, pumping to reservoir.

Filter.—Water passes to pump through stone, placed in a frame 8 ft. sq. and 4 ft. high, made of 2-in. oak plank.

Pumping Machinery.—Dy. cap., 1,280,000 galls.; Worthington pump with 10-in. water cylinders lifting 197 ft. to reservoir.

Reservoir.—Is 32 by 64 ft. and 8 ft. deep, lined with 2-in. white pine plank, and is 165 ft. above the town.

Distribution.—*Mains*, c. i., 1.5 miles. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, Hutchinson & Alexander, 12.

Consumption, 150,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $11,775. Capital stock, $10,000. No debt. Ann. op. exp., $550. Ann. rev.: consumers, $820; city, $300. Hydrant rental, $25, a 5 years' contract.

Management.—Prest., E. V. Marsh. Secy., F. S. Andrews. Supt., Geo. S. Thomas.

NEW BRIGHTON, *Beaver Co.* (Pop., 3,653; est., 5,000.) On Beaver river, 3 miles from its junction with the Ohio, on three terraces each about 100 ft. high. In coal region, and has deposits of clay used for stoneware and terra cotta. The river furnishes water-power used in manufacturing the above named and other articles. Settled about 1800.

History.—Built in '78-9 by New Brighton Water-Works Co. Engr., Jos. Flannery.

Water Supply.—Beaver river, pumping to reservoir and direct pumping. A caisson was sunk and tightly enclosed to keep out water from the sides, supply coming up from the bottom.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; a Worthington water-power and Wilson & Snyder steam pump.

Reservoir.—Cap., 500,000 galls.; is 312 ft. above river.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead. *Taps*, 350. *Meters*, 4. *Hydrants*, Mathews, 55.

Consumption, 300,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Cost, $65,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $4,250; city, $2,250. Hydrant rental, $44 for first 50, and $25 for additional.

Management.—Prest., R. S. Kennedy. Secy. and Treas., H. S. McConnel. Supt., Jno. D. King.

NEW CASTLE, *Lawrence Co.* (Pop., 8,418; est., 15,000.) At junction of Shenango and Neshannock rivers, the two forming the Beaver. On flat ground, surrounded by high hills. Manufactures iron, glass, sewer-pipe, fire-brick and coke; engaged in mining bituminous coal and iron ore, and in quarrying sandstone and limestone. Settled about 1800; incorp. a borough in '25; a city in '69.

History.—Built in '81 by City of New Castle Water Co. Engr., Jas. H. Harlow. Contr. for masonry and buildings, A. C. Megoun.

Water Supply.—Shenango river, pumping to reservoir.

Pumping Machinery.—Blake duplex pump, dy. cap., 2,500,000 galls.

Reservoir.—Cap., 7,500,000 galls.: in excavation and embankment, 150 by 188 ft. at the bottom, and 24 ft. deep. There is a berme 8 ft. wide at 14 ft. above the bottom. The bottom and slopes are covered with 2 ft. of puddle, and above the berme the slopes are paved with 15-in. of dry stone, laid on edge, on 9 in. of broken stone. The reservoir is 2 miles from and 266 ft. above the city.

Distribution.—*Mains*, c. i., 17 miles. *Services*, lead, kalamein i. *Taps*, 652. *Meters*, 3. *Hydrants*, Mathews, 117. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*: Ordinary, 120 lbs. Fire, 120 lbs.

Financial.—Cost, not given. Capital stock, $200,000. Bonded debt, $100,000. Int., not given. Ann op. exp., $5,000. Ann. rev.: consumers, $12,500; city, $5,400. Hydrant rental, ten years' contract, rate not given.

Management.—Prest., Jesse H. Lippincott. Secy. and Treas., L. H. Williams. Supt., J. W. Taylor.

NEW HAVEN, *Fayette Co.* (Pop., 442.) Included under Connellsville, which see.

NEWTOWN, *Bucks Co.* (Pop., 1,001; est., 1,400.) In a farming district, 10 miles from Trenton, N. J.

History.—Begun Aug. 12, '88, by Newtown Artesian Water Co., and to be finished about Nov. 20, '88, Engr. M. Van Harlingen, 308 Walnut street, Philadelphia. Contr., Thos. H. Regan, 752 South 12th street, Philadelphia. Sub-Contr. for masonry, A. Seagler, Doylestown; buildings, G. B. Girton, Newton.

Water Supply.—Two artesian wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 228,000 galls; Downie double-acting artesian well pump; boiler furnished by J. E. Thropp, Trenton, N. J.

Reservoir.—Cap., 500,000 galls.; 104 ft. sq. at ground line, and 12 ft. deep.

Distribution.—*Mains*, 8,6 and 4-in. c. i., 3½ miles. *Services*, not given. Pipe and specials furnished by Union Hydraulic Co., Philadelphia. Trenching sublet to Moore & Jordan, Phœnixville. *Taps*, not determined. *Meters*, none. *Hydrants*, Cassin, 22.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, $20,000. Debt, none. Ann. op. exp., not determined. Ann. rev.: consumers, not determined; city to be $275. Hydrant rental, $12.50.

Management.—Prest., Geo. C. Worstall. Secy., Paul Blake. Treas., Wm. Wynkoop. Supt., not appointed at time of report.

NORRISTOWN, *Montgomery Co.* (Pop., 13,063; est., 1,000.) On Schuylkill river, 16 miles above Philadelphia, on hilly land. Manufactures glass, iron, nails, tacks, cotton and woolen goods and has large marble and limestone quarries near by. Settled in 1778; incorp. a borough in '12.

History.—Built in '47 by Norristown Insurance & Water Co. Des. Engr., Wm. E. Morris.

Water Supply.—Schuylkill river, pumping to reservoir. Opposite the town an island a mile long divides the river in two channels, and water is taken from the further one.

Intake Pipe.—Is 20 in. in diam. and 1,450 ft. long.

Pumping Machinery.—Combined dy. cap., 8,000,000 galls. This includes a 5,000,000-gall. Worthington pump added in '88, a 1,000,000-gall. Worthington duplex pump, and a double-acting piston pump of 16-in. bore and 16-in. stroke, built by R. S. Newbold & Son. There has also been connected with the works a double-acting piston pump of 7¾-in bore and 60-in stroke, but it is not stated whether this is now in use. A new engine house was built and three new boilers were added in '88.

Reservoir.—Cap., 11,000,000 galls.; is 194 ft. above the river, in excavation and embankment, in two divisions with inner slopes lined with brick pavement on clay puddle.

Distribution.—*Mains*, c. i., about 37 miles. *Services*, lead. *Taps*, no data. *Meters*, none. *Hydrants*, various kinds, 150. *Valves*, principally Ludlow.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 63 lbs. Fire, 63 lbs.

Financial.—Cost, $325,000. Capital stock, $200,000. Bonded debt, $90,000. Int., 5%. Ann. op.exp., not given. Ann. rev.: consumers, not given; city, none. Hydrant rental being free.

Management.—Prest. and Supt., Jno. Slingluff. Treas., W. F. Slingluff. Secy., H. S. Seckler.

NORTH CLARENDON, *Warren Co.* (Pop., 295.)

History.—Date built not given; owned by an estate of which W. R. Elston is administrator.

Water Supply.—Artesian well, direct pumping for domestic use; pumping to tank for fire purposes.

Pumping Machinery.—Cameron pump, dy. cap., not given.

Tank.—Cap., 75,000 galls.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, w. i. *Taps*, about 85. *Meters*, not given, probably none. *Hydrants*, kind not given, 10.

Consumption, not given. *Pressure*, Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Cost, $4,000. Debt, not given. Ann. op. exp., not given. Ann. rev.: consumers, about $1,500; city, not given.

Management.—Administrator of estate, W. R. Elston. Supt., A. F. Crossman.

NORTH EAST, *Erie Co.* (Pop., 1,396; est., 1,500.) In dairy and agricultural section, 15 miles from Erie.

History.—Built in '86 by town.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, c. i., 5.5 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 29. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, about $20,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $450. Ann. rev.: consumers, $1,450; city, none.

Management.—Burgess, R. A. Davidson. Secy., N. H. Clark. Supt., E. W. Merrill.

OIL CITY, *Venango Co.* (Pop., 7,315; est., 12,000.) On Allegheny river and Oil creek, in center of oil district. Engaged in oil trade and manufacturing. Settled in '60; incorp. a city in '71.

History.—Built in '72 by city; Des. Engr., H. P. M. Birkinbine, Philadelphia, deceased. Const. Engr., Jno. Birkinbine.

Water Supply.—Allegheny river, pumping to reservoir, and springs by gravity.

Pumping Machinery.—Dy. cap., not given; two Eclipse pumps, having 24-in. steam, 12-in. water cylinders, and 30-in. stroke, and three 60 H. P. Norse tubular boilers.

Reservoir.—Cap., 2,500,000 galls.; in excavation and embankment, 320 ft. above the pumps and 310 ft. above the city.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. i., lead. *Taps*, 1,000. *Meters*, 30. *Hydrants*, Mathews, 190. *Valves*, Galvin.

Consumption, not given. *Pressure*: Ordinary, 120 lbs. Fire, 120 lbs.

Financial.—Cost, $160,000. Debt, $75,000. Int., 5 and 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $17,789; city, none.

Management.—Four Commrs. Supt., M. Dobson, South Oil City.

ORWICGSBURGH, *Schuylkill Co.* (Pop., 792; est., 1,500.)

History.—Built in '85 by town. No Engr. employed.

Water Supply.—Source not given, by gravity.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, galv. i., lead. *Taps*, 250. *Meters*, not given. *Hydrants*, kind not given, 17 in '85.

Consumption, not given. *Pressure*, not given.

Financial.—Cost, $13,000. Bonded debt, $13,000. Int., 4%. Ann. op. exp., $400. Ann. rev.: total, $1,100.

Management.—Supt., Thos. J. Reed. Report made by Geo. J. Irish.

OXFORD, *Chester Co.* (Pop., 1,500; est., 1,800.) On Elk creek, on rolling ground. Settled in '40; incorp. a borough in '59.

History.—Built in '69 by borough. Engr., Isaac S. Cassin, Philadelphia.

Water Supply.—Two bored wells, pumping to reservoir. Both wells are 8-in. in diam., one being 220 and the other 240 ft. deep. The supply was first taken from Elk creek, which had a drainage area of 3 sq. m. A crib dam formed an impounding reservoir and furnished power to drive a 14-ft. iron over-shot water-wheel which operated two double plunger pumps, and lifted water 137½ ft. to a reservoir, 74 ft. above the main street of the town.

Pumping Machinery.—Dy. cap., 115,000 galls.; one 4 and one 5-in. Knowles pump.

Reservoir.—Cap., about 500,000 galls.; is 80 ft. sq. at top, 40 at bottom, and 20 ft. deep, and 74 ft. above main street of town.

Distribution.—*Mains*, 6-in. c. i., 3.87 miles. *Services*, lead. *Taps*, 141. *Meters*, none. *Hydrants*, Cassin, Gloucester, 35 in '82. *Valves*, Gloucester.

Consumption, est., 40,000 galls. *Pressure*: not tested, but est. at 30 lbs.

Financial.—Cost, $44,283. Debt, $37,400. Int., average, 4.9%. Ann. op. exp., $950. Ann. rev.: consumers, $1,575.

Management.—Comm. of Borough Council. Secy., J. C. Kerr. No Supt.

PALO ALTO, *Schuylkill Co.* (Pop., 1,588; est., 2,050.) Near Pottsville.

History.—Supplied by Pottsville Water Co., date not given. All data included under Pottsville.

PARKERS' LANDING, *Armstrong Co.* (Pop., est., 1,800.) On Allegheny river.

History.—Built in '72 by Parker's Landing and Lawrenceburgh Water Co. Des. Engr., E. Versey.

Water Supply.—Allegheny river, pumping to tanks.

Pumping Machinery.—Cameron pump, dy. cap., 300,000 galls. The pump lifts water 420 ft.

Tanks.—Of wood; combined cap. about 100,000 galls.

Distribution.—*Mains*, c. i., wood, 8 miles. *Services*, galv. i. *Taps*, 240. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, about 100,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 140 lbs.

Financial.—Cost, $20,000. Capital stock, $10,000. Debt, not given. Ann. op. exp., (in '85) $1,800. Ann. rev.: consumers, (in '85) $2,800; city, $225 for all purposes.

Management.—Prest. and Supt., O. Tinsman. Treas., O. U. Fullerton.

PETROLIA, *Butler Co.* (Pop., 1,186.) In narrow valley on Bear creek, in center of petroleum basin of Butler Co. Incorp. in '73.

History.—Built in '74 by private company, name not given; purchased in 80 by Petrolia Water-Works Co., Limited. Now owned by T. Keighron. Des. Engr. F. S. Masson.

Water Supply.—Artesian well, pumping to tank for domestic use, and direct pumping for fire protection. The well is 5¾ in. in diam. and in '83 was yielding about 200,000 galls., daily, at a temperature of 51 degrees, Fahrenheit.

Pumping Machinery.—Two Blake pumps, dy. cap., not given. The second was added in '76 in connection with an independent fire main of 2½-in. wrought iron pipe. It has a 40 H. P. engine.

Tank.—Cap., 48,000 galls.; 175 ft. above city.

Distribution.—*Mains*, w. i., 2 miles. *Services*, galv. i., lead. *Taps*, 100. *Meters*, none. *Hydrants*, home-made, 6.

Consumption, not given. *Pressure*: Ordinary, 30 lbs. Fire, 150 lbs.

Financial.—Cost to '83, $8,000. No debt. Ann. op. exp., $1,700. Ann. rev.: consumers, (in '84), $1,200; city, none.

Management.—Owned by T. Keighron.

PHILADELPHIA, *Philadelphia Co.* (Pop., 847,170; est., 1,000,000.) On Delaware, river, 96 miles from the ocean, having an area of 129.2 miles. The Schuylkill river flows through the city, joining the Delaware and forming a peninsula 6 miles long and from 2 to 4 miles wide. The southern end of the city is on low, alluvial land, rising gradually to the north. The most of the old, and business part of the city occupies the narrowest portion between the rivers, and is from 20 to 40 ft. above the sea. West of the Schuylkill, and north of the old city the ground rises rapidly to a height of 400 ft., and is intersected by the valleys of several small streams, creating a very undulating surface.

The city was founded in 1682 by William Penn, who gave it a city charter in 1701, though it was not incorporated until 1789. The original city had an area of a little over 2 sq. m. This was not increased until '54 when the city limits were extended to include all the outlying towns in the county. A considerable part of this area is still open country, many of the towns near the borders remaining isolated, while others have been built around until included in the main part of the city. The city has a good water front, an extensive commerce, especially coast trade, and does a large amount of manufacturing. A large proportion of the inhabitants own the houses in which they live.

GENERAL SUMMARY.

Water Supply.—Schuylkill and Delaware rivers, and springs, pumping to reservoir and direct pumping. In '86 a population of 185,000 was supplied by direct pumping. The main supply of the city is taken from the Schuylkill river at the Fairmount, Spring Garden, Belmont and Roxborough stations. A comparatively small amount is taken from the Delaware river at the Kensington and Frankford stations, and a very small quantity from the springs at the Cnestnut Hill station.

Pumping Machinery.—Combined dy. cap., 188,300,000 galls., of which 33,300,000 galls. is by water-power, and the rest by steam. The pumps and pumping cap. is distributed by stations and the pumps are designated by numbers, as below:

Spring Garden—Total cap., 88,000,000 galls.; No. 6, 8,000,000-gall. compound rotary; No. 7, 20,000,000-gall. compound rotary; No. 8, 10,000,000-gall. Worthington duplex; No. 11. 20,000,000-gall. Holly-Gaskill: Nos. 9 and 10, each, 15,000,000-gall. Worthington duplex. These are numbered in the order put in use, Nos. 1-5 being abandoned, and 9 and 10 being at the new Spring Garden station.

Belmont.—Total cap., 18,000,000 galls.: Nos. 1 and 2, 5,000,000, and No. 3, 8,000,000, gall. Worthington duplex.

Roxborough.—Total cap., 14,750,000 galls.: No. 1. 2,250,000-gall. Cornish overhead beam; No. 2, 5,000,000, and No. 3, 7,500,000-gall. Worthington duplex.

Roxborough Auxiliary.—Total cap., as given, 500,000 galls.; No. 1, 500,000 gall., and No. 2—— gall. Knowles.

Mount Airy, auxiliary to Roxborough.—Total cap., 2,000,000 galls.: Nos. 1 and 2, each, 1,000,000 Davidson.

Chestnut Hill.—Total cap., 750,000 galls.; No. 1, 250,000-gall. Knowles pump; No. 2, 500,000-gall. Worthington duplex.

Frankford.—Total cap., 20,000,000 galls.; No. 1, 10,000,000-gall. Marine compound rotary; No. 2, 10,000,000-gall. Corliss compound rotary.

Kensington.—A 6,000,000-gall. Worthington duplex.

Fairmount, Water-Power.—Total cap., 33,300,000 galls.; all turbine wheels, No. 1, driving a 2,000,000, and Nos. 3, 4 and 5, 5,333,333-gall. pumps, these at new house. Nos. 7, 8 and 9 each driving a 5,100,000-gall. pump. Nos. 2 and 6 have been abandoned.

Summary of kind of pumps.—Ten Worthington: combined cap., 77,000,000 galls.; one Holly-Gaskill, 20,000,000; two Marine compound, 30,000,000; one Corliss, 10,000,000 one; Simpson, 8,000,000; one Cornish, 2,250,000; two Davidson, 2,000,000; three; Knowles, cap. of one not given, 750,000 galls.; seven turbines driving pumps with a combined dy. cap. of 33,300,000 galls.

Reservoirs.—Combined cap., 373,015,200 galls.: Fairmount, 26,350,794; Spring Garden, 12,009,581; Corinthian Avenue, 37,341,439; Lehigh Avenue, 26,394,180; Delaware or Kensington, 26,173,718; Roxborough, 12,838,455; Mount Airy, 4,546,917; Belmont, or George's Hill, exact figures not given, but probably 38,004,620; Wentz Farm, 19,356,496; East Park, 370,000,000 galls.

Distribution.—*Mains*, c. i., 876 miles. *Services*, w. i., lead. *Taps*, 163,816. *Meters*, 253. *Hydrants*, department design, 6,715.

Consumption, 88,850,000 galls. *Pressure*: 18 to 150 lbs.

Financial.—Cost, approximately, $15,000,000. Debt, $6,401,800. Int., not given. Ann. op. exp., $590,339. Ann. rev.: total, $2,030,434.

Management.—Bureau of Water. Chief Engr., Jno. L. Ogden. Asst. Engrs., Allen J. Fuller, Wm. Whilby. Genl. Supt., Frank L. Hand.

HISTORICAL DESCRIPTION.

The construction of water-works was begun by the city in 1800, and water was first supplied, Jan. '27, '01, the first works being known as the Centre Square. These were supplanted Sept. 7, '15, by works at Fairmount, water being pumped from the Schuylkill by steam-power, in both cases. Oct. 25, '22 the first wheel was started at Fairmount for a water-power supply and Jan. 14, '23, the use of steam at this station was discontinued. In '26 the city contracted to supply Spring Garden, Southwark and Northern Liberties, in '32 to supply Moyamensing and Kensington. Dec. 31, '44, the supply to Spring Garden, Northern Liberties and Kensington was discontinued, the two former places having built joint works and Kensington taking water from them until it built works which supplied water early in '51. In '51 a private company built works to supply Germantown, and in '55 the 24th Ward or West Philadelphia was supplied by works begun by it in '53. By consolidation in '54 all these works came under the control of the city. Chestnut Hill was supplied by a private company in '60. In '66 the Belmont works were begun and in '69 works were built for Roxborough, and the supply extended to Germantown, the city having controlled since '66 the works built by the company in '51. In '73 the city took charge of the Chestnut Hill works. A system was also built, date not given, to supply Frankford, Bridesburg and vicinity.

The various systems are described separately below, with as full and late details as can be obtained and given space.

THE FIRST OR CENTRE SQUARE SUPPLY.

The Engr. for these works was Benj. H. Latrobe, he having received orders from the City Council in 1798 to present a plan for taking water from the Schuylkill river. The population of the city at this time was about 70,000, supplied entirely from wells.

A marble lined basin 84 ft. wide and 200 ft. long extended to the river. Its bottom was 3 ft. below low water, and it was provided with tide-gates. A sluice led to a second basin, also marble lined, 40 ft. wide and 160 ft. long, from which water was conducted to a pump-well through an oval tunnel 6 ft. high, 300 ft. long, in rock, with its bottom at low water level. The pump-well was 10 ft. in diam. by 39 ft. deep, and in it was a double-acting force pump, of 17½ in. bore and 72-in. stroke, driven by an engine with a 40-in. cylinder and 72-in stroke, lifting water into a brick conduit 6 ft. in diam. and 3,144 ft. long, ending in a marble pump-house at Centre Square. From here it was lifted to tanks 56 ft. above the conduit bottom by a pump of 18-in. bore and 72-in. stroke, driven by an engine with 36-in. cylinder and 72-in. stroke. The tanks were of wood, placed 36 ft. above the ground, and had a cap. of 20,868 galls. Water passed from them to an iron chest 4 by 8 ft., from which it was distributed through 6-in. bored logs, reduced at successive points to 4½, 4, and 3 in.

The engine-house at the river was 54 by 66 ft., substantially built to contain two engines, but only one was ever put in. The engine house at Centre Square was a fine marble building, 60 ft. sq., 25 ft. high, with two porticoes, and a central rotunda 40 ft. in diam. and 60 ft. high, covered with a dome, through and above the center of which extended the smoke stack.

When these engines were built, in 1800, there were but three steam engines of any size in the United States, one of which was imported, and no pumping engines. The lack of tools for such work, and of experience, made the undertaking very difficult, as is attested by the time taken to bore the principal steam cylinder of the Centre Square works, nearly four months.

The contract for the engines was let to Nicholas J. Roosevelt, of the Soho Iron Works, near Newark, N. J. He agreed to construct the two engines, with a dy. cap. of 3,000,000 galls. raised 50 ft., and to maintain and keep them in repair five years, for $30,000. It is said that he claimed they cost him $77,192. Both engines had their lever beams, fly wheels, shafts and arms, cold water pumps and cisterns, *all of wood.* The main steam cylinder of the Centre Square engine was cast in two sections, which were united by copper, and secured externally by a cast-iron band 18-in. wide. The boilers were wooden boxes, 9 ft. sq. and 15 ft. long, of 5 in. white pine plank, bolted through and braced on the outside. The fire-box inside the boiler was of wrought-iron, with vertical cast-iron flues. The boilers leaked badly, and in Dec., '04, the one at the river, and in '06 that at Centre Square, was replaced by one of cast-iron. These were used until '15. The pumps had to be lined with sheet copper to make them air-tight.

In '07 the forging and finishing of a 4-in. piston rod, 10 ft. long, was especially noted, and the workingmen commended, in the report of the "Watering Committee." In '09 a cast-iron fly-wheel shaft replaced a wooden one, and in '10 air chambers were added to the Centre Square pump, but they were useless until lined with sheet lead. In '09 the expense of operating the pumps was $13,807.23.

A Report on the Introduction of Wholesome Water into Philadelphia, dated '01, states that the engineer who built the works, Benj. H. Latrobe, received for his services to that time, $6,350, and they extended over a period of at least three years, though most of the construction was in 1800. The report also states that the works cost, in '01, $220,310.55½.

The works described above were supplanted in '15 by an independent supply taken at Fairmount. The cost of the original works, from Mar., 1799, to Sept. 1, '15, when the Fairmount works were started, was $657,398.91, including all expenses. For the same time the gross receipts were $105,351.18, which, without interest, left a deficiency of $552,047.73. The water rents in '01 were $278, and the number of tenants supplied was 34. In '14 the water rents were $17,883 and the number of tenants 2,850. In the latter year the average daily supply was 968,383 galls., or 340 galls. a tenant.

In '01 the length of wooden pipe laid was 7,000 ft., and the next year 29,963 ft. were laid. At the close of '06 a total of 125,635 ft. had been laid, or nearly 24 miles. From '06 to '14 only a little over 7 miles was laid, making a total of 31 miles of wooden pipe connected with the original works at the close of '14, and 3,978 ft. of iron pipe which had been laid in '04. The Engr. of the works to '02 was Benj. H. Latrobe, in '03 and '04, Jno. Davis, who was succeeded in '05 by F. Graff, Sr., who held the office until '47.

SUPPLY BY STEAM PUMPING AT FAIRMOUNT.

In '11 a report to the Common Council was made by Jno. Davis and Frederick Graff proposing an additional supply from the Schuylkill at Fairmount. The report was adopted, the new works begun Aug. 1, '12, and put in operation Sept. 7, '15, and at the latter date the use of the Centre Square works was discontinued. There was a Bolton & Watt engine of 44-in. cylinder and 72-in. stroke, driving a double-acting pump of 20-in. bore and 72-in. stroke, lifting water through 239 ft. of 16-in. main to a reservoir 102 ft. above low water in the Schuylkill. The reservoir had a cap. of 3,280,265 ale, or 4,004,483 wine galls., and water was conveyed from it to the distributing chest in Centre Square, 9,337 ft. distant, through 5 lines of 6, and one of 4½-in. wooden logs, carried along the bed of the old Union Canal to Broad street, thence to the chest.

The boiler of the engine at the new works had a cast-iron case with vertical flues of wrought iron carrying a steam pressure of 2⅜ to 4 lbs. No furnace could be found sufficiently large to cast entire the steam cylinder of the engine, so the nozzle pipes were cast separately and bolted on, though they weighed but 1⅜ tons. Most of the castings were made at Weymouth blast furnace, in N. J., but the smaller ones were cast in the city, at the Eagle Works. The trial of the engine showed a dy. cap. of 2,116,382 wine galls., with 7 cords of wood.

Before starting the Fairmount works a contract was made with Oliver Evans for one of his high-pressure engines, then coming into use. It was put in operation Dec. 15, '17. It had a 20-in. steam cylinder with 60-in. stroke, and a 20-in. pump with 48-in. stroke. There were four cylinder boilers, 30 in. in diam. and 24 ft. long, upon which 220 lbs. pressure was sometimes carried. A test showed the dy. cap. of the pumping engine to be 3,754,931 wine galls., with 24¾ revolutions a minute, 194 lbs. of steam, and a consumption of 13 cords of wood.

As will be seen by the estimate, made by the Supt., of the cost of operating the Oliver Evans engine for one year, the expense was very heavy. The average daily amount pumped during the year was 2,300,000 ale galls., and the expense:

Six men at $9.75 per day	$ 3,559
Tallow, Chandlery, etc	1,250
3,650 cords of wood and handling	24,550
Wear and tear of machinery	1,500
	$30,858

Or $36.60 for each million ale galls. pumped to reservoir, equivalent to $44.68 to each million galls. of 231 in. raised to the reservoir, and to $0.4381 to each million galls. raised 1 ft.

The cost of the steam works at Fairmount, including yearly expenses, from beginning of construction, Aug. 1,'12, to July 1, '22, when the water-power works were started, was $809,318.04. The total expenditures on the work to the end of '23 were $1,469,097, and the total water rents $280,231, leaving a deficiency of $1,188,866. The number of tenants or takers, in '22 was 4,758 and the rents from them $25,485.50. To the end of '22 there had been laid 216,697 ft., or 41.4 miles of wooden pipe. There had also been laid 38,458 ft. or about 7.3 miles of iron pipe. Of the iron pipe, 3,978 ft. had been laid in '04, 400 ft. in '17 and all the rest in '20, '21 and '22. The iron pipe laid in '04 and '17 was afterwards taken up and sold.

WATER-POWER WORKS AT FAIRMOUNT.

In '18 the general plans of Frederick Graff, Sr., for a water-power supply from the Schuylkill at Fairmount were adopted.

The plan for the dam across the river was made by Ariel Cooley, of Chicopee, Mass., and Apr. 8, '19, the City Council awarded him the contract for its construction, the price being $150,000. Works was begun 11 days later, Apr. 19, and water flowed over the dam July 25, '21. The first wheel was started July 1, '22, and put in operation for supplying water Oct. 25, '22. Jan. 14, '23, the use of the Fairmount steam works was discontinued. Wheels and pumps were added to these works from time to time, the ninth, a turbine, on Dec. 16, '51.

At the point where the dam was built the river was about 900 ft. wide. Its bottom was of rock, which for one-fourth of the distance on the east side was covered with 11 ft. of mud. The greatest high-water depth was 30 ft. and the river shoaled gradually to the west shore.

On the rock bottom the dam was of log cribs, filled with stone, each crib being about 50 ft. long on the axis of the stream and 17 to 18 ft. wide. They were planked on the upper side, backed with earth, and carried 13½ ft. above low-tide. On mud bottom the dam was of stone spalls and earth, 150 ft. wide at the bottom, 12 at the top, carried 15 ft. above the other part of the dam, or 28½ ft. above low tide. The top and the up-stream slope was paved with stone 3 ft. thick, and a stone pier between the bank and overfall protected the bank, or mound dam.

The dam was built obliquely across the stream to give an overflow of 1,204 ft. of 13½ ft. fall at low tide. The mound dam being 270 ft. long, the piers about 22 ft., and the wall with arches to convey water to the wheels, 104 ft., the total length of the dam was 1,600 ft. It backed up the water for 6 miles.

The timber in the cribs of the dam was hemlock, and in '42-3 this was replaced from low tide up with white pine, and the overfall extended to a length of 1,143 ft., 10 in. The work was done with coffer dams at great risk and expense.

In '65 the dam was strengthened by placing below 450 ft. of its highest part cribs filled with stone, each crib being 30 ft. wide on the axis of the stream, and 8 ft. long. Round hemlock timber was used from low water down, finished above with hewed white pine and decked with white oak.

In '72 a new dam was built directly in front of the old one, upon rock at the west end, and upon the cribs sunk in '65. The overfall of this was 1,112 ft. long, and had two inclined aprons, with a drop between them, the lowest part being 2 ft above low water. The space between the old and new dams was about 6 ft. wide on top, and was filled with concrete.

The first 9 wheels connected with these works were all breast wheels, save the last, a turbine. The first three were started about '22, after which one was added in '27, in '32 in '34, two in '43, and the turbine in '51. The diam. of the various breast wheels was from 15 to 18 ft., and each was 15 ft. wide, and they made from 11 to 14 revolutions a minute. The turbine was 7 ft. in diam. and had 10 by 13 in. buckets and made 12 revolutions a minute. The pumps were all of 16 in. bore and from 4½ to 6-ft. stroke. The nine pumps had a combined dy. cap. of 17,309,256 galls. Wheels Nos. 1, 2 and 3 were of wood, and were replaced with iron, July, '46, after constant use for 24 years. Nos, 4, 5, 6, 7 and 8, were of cast-iron with wooden buckets, each weighing about 22 tons. All had cast-iron shafts working under 1 ft. head and 7½ ft. fall, when the dam was full and the tide low. At high tide water rose 2 ft. above their lower edges, preventing use for 4 to 6 hours each day.

The total cost, in '52, of running the nine wheels and pumps was $7.67 a day, or $1.33 for each million galls. raised to the reservoirs, or 1.3 cents for a million galls. raised 1 ft.

In '62 an additional wheel-house was built to utilize the surplus water during several months, and three Jonval turbines put in, each working two double-acting 18-in. pumps with strokes of 72 in. In '69 two of the old breast wheels were replaced by a turbine, two more in '70, and two in '71. In '79, 7 turbines ran 52 per cent. of the time, pumping to the reservoirs 20,000,000 galls. a day. The full dy. cap. of the pumps was 36,000,000 galls., but they cannot be run continuously. During 12 consecutive days in '79 only 8,000,000 galls. a day could be pumped. In the report for '87 the combined dy. cap. of the 7 turbines is given as 33,300,000 galls. In '72 a Worthington steam pump was placed at these works for use in the summer months

The cost of the water-power works, with yearly expenses for maintaining and extending the whole system, from July 1, '22 to Dec. 31, '52 was $1,781,177. The total cost and expenses of the water-works from March 1799 to Dec. 31, '52, was $3,247,894. The water rents for the same time amounted to $3,434,382, which gives a balance in favor of the water-works of $77,755. The yearly revenue increased from $278 in '01 to $175,466 in '52. The yearly expense was below the yearly revenue until '30 when it rose from $28,867 below, in '29, to $33,258 above in '30. The number of tenants, or taps in '01 was 34. The av. dy. consumption is not given until '14, when there were 2,850 taps, an av. dy. consumption of 968,383 galls., or 340 galls. a tap. In '54 all the figures for comparison are not given, but in '53 there were 32,300 taps, the consumption was 7,607,157 galls., or 235 galls. a tap. The highest av. dy. consumption recorded up to '53, was 407 galls. in '23, and the lowest, 198 galls. in '46. The av. dy. consumption for 34 years recorded was 255 galls. These years were '14, '15, '17 and '23 53, inclusive. The year of greatest consumption per tap, '23, was just after the completion of the Fairmount water-power works, and that of least consumption, '46 was when there were but the eight breast water-wheels at the station and while the three wooden ones were being replaced by cast-iron.

The last wooden pipe was laid in '32, being but 200 ft. for that year, and making a total of 241,604 ft., or a 45.8 miles. The first iron pipe, 3,978 ft., was laid in '04, and the next in '17. This was taken up soon afterwards. In '18 the Committee resolved to lay iron pipe thereafter, and began doing so in '20, but not to the exclusion of wooden pipe, until the end of '32, there being laid from '20 to '32, inclusive, 7.1 miles of wooden, against 47 miles of iron pipe.

The works described thus far were built for the supply of the old city. In '54 there came under the control of the water department the works previously built by the towns which in that year were consolidated with Philadelphia and since then new works have been built for the supply of different localities.

THE SPRING GARDEN WORKS.

Until '26 the districts north of Vine street, including Spring Garden, Northern Liberties and Kensington, all formerly called Northern Liberties, had no general public water supply. In this year these districts made a contract with the authorities of Philadelphia for a supply from their works at Fairmount, which continued in force until Dec. 31, '44. The rate was 50 per cent higher than that in the city, 6 per cent being allowed for collection. The frontage for the mains was paid by the respective property owners.

then a 500,000-gall. Worthington duplex pump has been added, and the dy. cap. of this station is now 750,000 galls.

ROXBOROUGH AND GERMANTOWN SUPPLY.

For the supply of these two places, in the northwestern district, and south of Chestnut hill, works were begun in '66. Water was raised from the Schuylkill river by pumps driven by turbines, and by a 2,250,000-gall. Cornish over head beam engine built by Matthews & Moore. Both were started in '69.

The pump had 72-in. steam and 20-in. water-cylinders, all of 120-in. stroke, and lifted water to a reservoir against a head of 334 ft. In '72 a 5,000,000-gall. and later a 7,500,000 gall.-Worthington pump was added.

In '75 a stand-pipe was finished, which, with two Knowles pumps, furnished water to Germantown. The stand-pipe was made of ordinary 30-in. mains.

The dy. cap. of the present main station is 14,750,000 galls.; of the Roxborough auxiliary, 250,000 galls.; of the Mount Airy auxiliary 2,000,000 galls., there being two Davidson pumps here.

BELMONT WORKS.

Begun in '66 and put in operation in '70; located at Belmont, on the Schuylkill, a short distance above the old 24th Ward, or West Philadelphia, works, which these supplemented. Engine No. 1 was started in '70, No. 2 in '71, and No. 3 later. All were Worthington pumping engines, the first two of 5,000,000 galls. dy. cap., each, and the last of 8,000,000 galls, and pumped to a reservoir against 212 ft. head. These works are for the exclusive supply of West Philadelphia, and in '87 stand as above, with a combined dy. cap. of 18,000,000 galls.

FRANKFORD WORKS.

Supply Frankford, Bridesburg and their vicinity, by pumping from the Delaware river at Lardner's Point. A 9,500,000-gall, Cramp and a 2,500,000-gall Worthington engine were first placed at this station, but there are now at this station two compound rotary engines, one a marine and the other a Corliss, and each having a dy. cap. of 10,000,000 galls.

RESERVOIRS.

Fairmount.—Filled from Fairmount pumping station, and supplies that part of the city, from river to river, lying below South street. It is in four basins, the fourth having three sections; is 94.14 ft. above the city datum, 51 ft. above the highest, and 91 above the lowest curb in the old city proper. Its storage cap. is 26,350,794 galls., or 3½ days supply for this section of the city, as the av. dy. consumption in '86 was about 8,000,000 galls.

The reservoir is in earthwork, lined with brick, and is 12¼ ft. deep. The first basin, finished in '15, is 167 by 317 ft.; the second, finished in '21, is 140 by 316 ft.; third, finished in '27 is 160 by 317 ft.; first section of fourth, finished in '35, is 136 by 350 ft.; second section of fourth, finished in '35, third, in '36 the third and fourth together being 358 by 392 ft. The first basin cost $32,509; second, $9,579; third, $24,522; fourth, $67,214. Total cost, $133,824.

Distributing Mains from Fairmount Reservoirs.—The first, was 22 in. in diam. for 2,561 ft., then reduced to 20-in., and partly of pipe imported from England, was begun in '19, and was 12,177 ft. long. The second, laid in '29, was 11,823 ft. long, 20 in. in diam. for the first 10,956 ft., then 16-in. The third, laid in '50, was 13,821 ft. long and 30 in. in diam.

Spring Garden Reservoir.—Cap., 12,009,581 galls.; built in '44, and is supplied from Spring Garden and Fairmount works. Has puddled earth embankments, and is lined with brick. When first filled the bank broke, but it was successfully repaired. Its water level is 115 ft. above the river, and its depth 17 ft.

Corinthian Avenue Reservoir.—Cap., 37,341 439 galls.; finished in '52, and is supplied from the Fairmount and Spring Garden Works. Until '60 it never held over 11 ft. of water without leaking, but it has since been repaired so it holds about 25 ft. When full the water level is 120 ft. above city datum, 66.94 ft. above the highest and 98.14 ft. above the lowest curb in the city, and 16 ft. higher than the Fairmount reservoir. To fill it a stand-pipe was built at Fairmount, of 48-in. cast-iron pipe 50 ft. high from its base, 30 ft. above the level of the Fairmount, and 14 ft. above level of the Corinthian avenue reservoir. To this stand-pipe the force main of the Fairmount works is attached so as to throw its supply into the Corinthian avenue reservoir, when desired. From the base of the stand-pipe a 30 in. main is carried 3,747 ft. to the Corinthian avenue basin. The cost of constructing the reservoir, to '52, when water was admitted, exclusive of land damages, was $46,030.

The supply reaches the Corinthian Avenue reservoir from the Spring Garden Works through a 30 in. main, and, when the Fairmount reservoir is full and the river up, from the Fairmount works *via* the stand-pipe through a 48-in. and a 30-in. main. It has four 30-in. outlets; one to Kensington basin; one to the First district, south of South Street; one to Spring Garden district; and one blank. In '66 the introduction of a supply through a 48-in. pipe, over the bank, and dropping 9 ft. on the lining-wall, caused a slide of the wall and some other damage.

Lehigh Avenue Reservoir.—Cap., 26,394,180 galls.

The Corinthian Avenue, Spring Garden and Lehigh Avenue Reservoir supply the city north of South St. to Westmoreland, except a part supplied by direct pumping. The storage cap. of the three reservoirs is 75,745,200 galls. and the av. dy. consumption of this district having been 30,000,000 galls. in '86 they give a storage for but 2½ days.

Delaware or Kensington Reservoir.—Three basins, combined cap., 26,173,718 galls. The two old basins have a cap. of 9,800,000 galls., are formed by embankments puddled with clay and lined with brick. In '71 a new basin was built adjoining the old ones; cap., 16,373,718 galls. The water surface of the third basin covers an area of 4.83 acres. It is in embankments built in 6 in. layers, rolled with grooved rollers! and having slopes of 1½ to 1, lined with brick set on edge in cement. The bottom was paved with brick laid flat. When full, the water surface of the reservoir is 112 ft. above meantide. Two 18-in. distributing mains lead from it.

Roxborough Reservoir.—Cap., 12,838,455 galls. Supplies Manayunk, or 21st. Ward, which had a dy. consumption of 2,350,000. in '86; storage, 5 days. Finished in '68. Is 375 ft. above tide, 365 ft. above city datum and is 410 by 240 ft., by 12 ft. deep. Embankments are of disintegrated mica schist, with clay lining. When first filled for 6 ft. it leaked, and after being repaired and filled a few feet more it again leaked, necessitating further repairs.

Mount Airy Reservoir.—Cap., 4,545,917 galls. Supplies the 22nd and a part of the 28th Wards, which in '86 had a dy. consumption of 2,350,000 galls.; storage, less than two days. Is 362 ft. above city datum, and is filled from Roxborough station, there being auxiliary pumps here. This reservoir was built in connection with the old Germantown works.

Belmont or George's Hill Reservoir.—Cap., about 40,000,000 galls. Supplies West Philadelphia, which in '86 had a dy. consumption of 8,000,000 galls.; storage, 5 days. The reservoir is filled from the Belmont station, was begun in '66 and finished in '70.

Wendz Farm Reservoir.—Cap., 19,356,496 galls. Supplies Frankford and Bridesburg, which had a consumption of 2,419,562 galls. in '86; storage, 8 days. Filled from Frankford station, on Delaware river, and was finished in '77. In embankment, formed of micaceous sand, with slopes of 2 to 1 lined with clay puddle. This reservoir was built to hold 24 ft. of water, or 36,046,097 galls., which would give 15 days storage, but owing to defective construction it can be filled but 14 ft.

East Park Reservoir.—Cap.: first section, 60,000,000 galls.; second section, 310,000,000 galls. Begun in '71 and nearly ready for lining in '77, but work on it was abandoned for several years, the first section being finished in '87, the second in '88. When completed the third and last basin will make the combined cap. of the reservoir 700,000,000 galls. It will be filled from the Spring Garden or Belmont station and will be of great value as a settling basin, aside from storage.

The work done on the reservoir in '87 consisted almost wholly of lining it, and the contract was given to Lewis Grant, Pottsville, for $1.29 a sq. yd. The bottom lining is a 5-in. layer of concrete, composed of 4 parts of broken stone, 2 of sharp sand and 1 of best Portland cement. The concrete was joined to form one continuous sheet over the bottom, and the upper surface covered with a composition of 2 parts of sand and 1 of cement. The sides are paved with hard brick, laid flat in 2 in. of cement mortar composed of 2 parts of sand and 1 of cement.

RIVER CROSSINGS.

In '70 a pipe aqueduct was laid over Wissahickon creek after designs by F. Graff. Two lines of 20-in. cast-iron pipe with flange joints formed the top chord of a 165-ft. span which was trussed by wrought-iron links, and rested on Phœnix columns, the pipe being 100 ft. above the creek. In Feb., '75, one of the pipes were destroyed by frost, and in '76 a siphon was substituted for the bridge, the pipe being laid in an oak cradle, then submerged. The pipe at the lowest point is under 295 ft. head. It is 20 in. in diam. and 11-16 in. thick.

In '68 Mr. Graff laid a 36-in. pumping main across the forebay at Fairmount in a similar way.

In '70 a submerged pipe 963ft. long was laid across the Schuylkill in 25 ft. of ater. It had Ward's flexible joint.

DATE OF IMPORTANT EVENTS CONNECTED WITH THE WATER-WORKS OF PHILADELPHIA, 1789 TO 1875.

June 23, 1789.—Benjamin Franklin's will to dam the Wissahickon, and bequeaths £100,000.

April 10, 1792.—Charter of the Delaware and Schuylkill Canal Co.

1793.—Yellow Fever.

1797.—First petitions to Councils, asking for the introduction of pure water into the city.

Jan. 31, 1798.—Councils offered £50,000 for one-half the water of the Delaware and Schuylkill Canal.

July, 1798.—Benjamin Henry Latrobe surveyed Spring Mill Creek, and reported to Councils.

Dec. 29, 1798.—Latrobe's review of proposed schemes. 1st. Aqueduct from Spring Mill. 2d. Wissahickon Creek. 3d. Water-power works. 4th. Impounding reservoirs.

Jan. 1799.—Latrobe's plan for Centre Square and Schuylkill works adopted.

Feb. 7, 1799.—Ordinance passed authorizing a loan of $150,000 for purpose of supplying the city with water.

March, 1799.—First works commenced under the superintendence of B. H. Latrobe.

Jan. 21, or 27, } 1801.—The first water was supplied from these works.

1801.—Fourteen pieces 6-ft. cast-iron pipe laid at Centre Square engine house to prove best mode of securing joints under greatest pressure.

Oct. 12, 1801.—City Councils approved of the Report of the Committee for superintending the introduction of wholesome water into the city.

1803.—John Davis as Superintendent.

1803.—Public hydrants, pumps and iron fire-plugs first introduced, up to and including which time the cost of the works was $295,452.09.

1804.—Four cast-iron fire-pugs in use.

1804.—The first iron pipes laid, 3,978 ft., as an experiment, in Water street.

1804.—Cast-iron boiler at Centre Square works cost $234.79.

1805.—Frederick Graff, Sr., Superintendent.

1809.—Expense of keeping steam engines going was for the Schuylkill engine $6,251 36
And Centre Square Engine 7,552 87

Together $13,807 23

1811.—Up to this time there were 230 hydrant pumps, and 185 fire plugs in the city.

Oct. 24, 1811.—Councils directed the Watering Committee to enquire for a better method of supplying the city. Up to this time the cost of the works was, for engine building, canals, tunnels, etc $248,985 59
For distribution, logs, etc 259,525 92

Total $508,511 51

Dec. 18, 1811.—John Davis and Frederick Graff made surveys of Wissahickon and Spring Mill Creeks, and the east side of the Schuylkill, from Upper Ferry Bridge to the Falls, and reported in favor of steam works at Fairmount, which report was adopted.

June 28, 1812.—First purchase at made Fairmount for $16,685.67.

Aug., 1812.—The steam works at Fairmount commenced.

Feb. 16, 1813.—Bill authorizing city to lay pipes through the streets of the district passed Legislature.

The cost of keeping the engines going, was, for Schuylkill engine $11,900 07
For Centre Square engine 13,740 18

Total $25,640 25
to raise 793,250 ale galls per day.

Sept. 7, 1815.—Started steam works at Fairmount, and finished reservoir No. 1 when Centre Square works were discontinued.

1817.—First iron pipes, similar to those now in use, were laid, imported from England.

1818.—Committee resolved to lay iron pipes in future; Cherry street shop erected.

June 20, 1818.—The boiler of Oliver Evans' engine burst.

Jan. 26, 1819.—Committee approved of the plan of distribution of iron pipes as devised by Frederick Graff.

April 8, 1819.—Councils resolved to erect water-power works at Fairmount.
April 19, 1819.—Building of the dam was commenced by Captain Ariel Cooley.
July 20, 1819.—Authority was obtained to raise the dam 18 inches higher than at first contemplated.
June 25, 1820.—First iron main laid 20 and 22-inch diameter.
July 23, 1821.—Last crib sunk.
July 25, 1821.—Water flowed over dam first time.
April 28, 1821.—Register water rents adopted.
July 1, 1821.—Corner stone of mill buildings laid on Saturday.
Oct. 25, 1822.—First water wheel started to work to supply city, Monday.
Jan. 14, 1823.—Use of steam works at Fairmount discontinued.
1824.—Extra water-power purchased from Navigation Company for $26,000.
June 14, 1824.—Agreement from Schuylkill Navigation Company to protect the Fairmount pool from dye stuffs, noxious, fetid, or injurious substances.
April 26, 1826.—Contracted to supply Spring Garden.
June 1, 1826.—Contracted to supply Southwark.
June 6, 1826.—Contracted to supply Northern Liberties.
Nov. 10, 1827.—Wheel No. 4 started; reservoir No. 3 finished.
April 12, 1828.—Act to protect the purity of the Schuylkill river.
1829.—Second main laid from Fairmount.
1829.—Centre Square engine building taken down.
Feb. 13, 1829.—Bill to prevent passage of streets through Fairmount passed Legislature.
Oct. 10, 1831.—Second contract to supply western part of Spring Garden.
Feb. 7, 1832.—Act to prevent Fairmount pool from pollution.
Mch. 26, 1832.—Building guard pier.
April 5, 1832.—Wheel No. 5 started; 22 inch main taken up and relaid on the railroad.
June 6, 1832.—Contract to supply Moyamensing.
Oct. 5, 1833.—Contract to supply Kensington signed.
Nov. 5, 1834.—Wheel No. 6 started.
Dec. 20, 1834.—Bill for protection of purity of Schuylkill water passed the Legislature.
Nov. 4, 1835.—First section of No. 4 reservoir finished.
1835.—Pavilion at the end of dam built and old engine building altered to a public saloon.
Nov. 12, 1836.—Second and third section of No. 4 reservoir finished.
1837.—Retaining wall on Fairmount, twenty-fifth street built.
1840.—New set of forebay head gates put in.
May 2, 1812.—Rebuilding the dam from low tide up, commenced.
Dec. 7, 1843.—Rebuilding the dam from low tide up finished; cost, $56,216.85.
Aug. 24, 1843.—Started wheels Nos. 7 and 8. Put in new head-gates for all the flumes.
Dec. 31, 1844.—Supply of water discontinued to Spring Garden, Northern Liberties, and Kensington.
Jan. 1, 1845.—New contract to supply Moyamensing and Southwark for ten years from this date.
July 14, 1846.—Started wheels Nos. 1, 2, and 3, which had been rebuilt, with their pumps.
1846.—Took up 3-in. pipes in Water street, and relaid with 6-in. per Girard's Will.
1847.—Frederick Graff, Chief Engineer.
Mch. 9, 1847.—Bill to vacate Biddle street passed Legislature.
1847.—Enlarged the Garden and put up iron railings.
Nov. 11, 1848.—Supplied the northern districts for two weeks whilst they repaired their reservoir, which was partly carried away.
July 5, 1849.—Councils authorize the laying of 30 in. main from Fairmount.
Aug. 30, 1849.—Councils agreed to purchase lot for new reservoir.
1850.—Purchased thirteen acres, one hundred and fifteen perches, on part of which Corinthian Avenue Basin now stands.
1850.—30-in. main laid from Fairmount.
April 21, 1851.—New reservoir commenced, Corinthian Avenue. Cleansed reservoirs Nos. 1 and 3, and one section of No. 4.
Dec. 16, 1851.—Turbine started. Cleaned Reservoir No. 2.
Dec. 22, 1852.—Water admitted to new reservoir. Cost to Dec. 31, $46,030.47.
1852.—Hydrographic survey made by the Schuylkill Navigation Company.
1855.—The wine gallon (of 231 cubic inches) adopted in place of the ale gallon (of 282 cubic inches).
1855.—Stand-pipe erected at Schuylkill Works, and overhead Cornish engine started.
August, 1855.—Twenty-fourth Ward Works went into operation.
1856.—Samuel Ogden, Chief Engineer.
1858.—H. P. M. Birkinbine, Chief Engineer.
1859.—Corinthian Avenue Reservoir raised 9 ft., and work commenced on the new mill house at Fairmount, under Chief Engineer H. P. M. Birkinbine.
1859.—A suggestion to abandon the Delaware Works.
1859.—A 30 in. main laid from the Corinthian Avenue Reservoir, to supply the southern sections of the city.
1861.—Hydrographic survey of Fairmount pool to Columbia Bridge, made by Chief Engineer Birkinbine.
1862.—Isaac Cassin, Chief Engineer.
June, 1862.—The machinery in the new mill house at Fairmount started.

Sept., 1862.—Spring Garden Works stopped for 14 days, the forebay having been filled with earth by a freshet.

1864.—H. P. M. Birkinbine, Chief Engineer. A second hydrographic survey made to Columbia Bridge.

1865.—The wharf at Delaware Works extended to Port Warden's line, a distance of 125 ft., and stand-pipe erected.

1865.—Roxborough reservoir commenced.

1865.—H. P. M. Birkinbine, Chf. Engr., reports a plan for a gravity supply from the Perkiomen.

May, 1866.—Germantown Works came under the care of the Department.

1866.—30-in. main laid, connecting the Corinthian Avenue Reservoir with the Delaware Reservoir.

1866.—A third hydrographic survey made as high up as Reading Railroad Bridge at the Falls.

1866.—48-inch main laid from Fairmount to Corinthian Avenue Reservoir.

1866.—Belmont Reservoir commenced.

1867.—Frederick Graff, Chief Engineer.

Aug., 1867.—Spring Garden Forebay twice filled with gravel by heavy rains washing the Reading Railroad embankment.

Oct., 1867.—The removal of old breast wheels, Nos. 2 and 3, at Fairmount, commenced under Chf. Engr., F. Graff.

1868.—Old Engine No. 1. at Schuylkill Works, removed, and the erection of the side lever Cornish Engine commenced.

1868.—Cross head of the Sutton engine at Spring Garden broke.

Feb. 17, 1869.—New Turbine, (in place of breast wheels Nos. 2 and 3) started, and the removal of old breast wheels Nos. 4 and 5 commenced.

1869.—Drought during the month of August.

April 5, 1869.—Cornish engine at Roxborough Works started.

Oct. 4, 1869.—Greatest freshet on record in the Schuylkill River; the water rose 11 ft., 9 in., above the level of the dam.

Nov. 3. 1869.—The side lever Cornish engine at the Schuylkill works started.

1870.—New section of Delaware Reservoir commenced.

June 20, 1870.—The second new turbine at Fairmount (now No. 4), started, and the removal of old breastwork wheels Nos. 6 and 7 commenced.

1870.—Belmont reservoir completed.

Sept. 19, 1870.—No. 1 Worthington duplex engine at Belmont started, and the old West Philadelphia Works abandoned.

1870.—Five new tubular boilers erected at the Schuylkill Works.

1870.—Submerged main laid across the Schuylkill River at Belmont.

1870.—Pipe aqueduct across the Wissahickon Creek completed.

March. 1871.—Water passed over the pipe aqueduct to Mount Airy Reservoir.

July 18, 1871.—The second Worthington engine at Belmont started to regular work.

Aug. 19, 1871.—The Belmont Works commenced to supply the high ground of the Twentieth and Twenty-ninth Wards.

1871.—New aqueduct built connecting the Spring Garden forebay with the river.

Oct. 25. 1871.—The Worthington engine at Delaware Works started.

Nov. 9, 1871.—East Park Reservoir commenced.

Dec. 14, 1871.—The third new turbine (now No. 5), in place of wheels Nos. 6 and 7 at Fairmount, was ready to start.

Dec. 20, 1871.—New section of Delaware Reservoir finished and filled.

1872.—Compound engine at the Schuylkill Works started.

June 1. 1872.—Rebuilding of the new dam commenced.

Aug. 1, 1872.—Worthington duplex engine at Roxborough Works started.

Sept. 30, 1872.—Old Germantown Works abandoned.

Dec. 19, 1872.—Water let into the western section of the Belmont Reservoir.

Jan. 20, 1873.—Department took possession of the Chestnut Hill Water-Works.

March 1873.—Wm. H. McFadden Chief Engineer.

1874.—The rain-fall of April served to June 26, when a severe drought set in and continued to November 23. The minimum flow of the Schuylkill was never less, unless in the succeeding Spring of 1875, due to the severe winter not permitting the springs to be replenished.

April 15, 1874.—Commenced to clean all sections of Fairmount Basin: removed nearly 6,000 cu. yds.

Feb. 17, 1875.—Pipe bridge across the Wissahickon broken by freezing.

1875.—According to ordinance of Council of June 5, the Franklin Institute nominated the following eight engineers: Frederick Graff, Jas. F. Smith, Wm. E. Wilson, Wm. Milnor Roberts, Wm. E. Morris, Wm. J. McAlpine, Solomon W. Roberts, and Fairman Rogers, of whom his Honor, the Mayor, appointed five, viz: Messrs. W. Milnor Roberts of New York, Wm. J. McAlpine of Albany, Wm. E. Morris, Solomon W. Roberts and Fairman Rogers of Philadelphia, who together with Dr. Wm. H. McFadden, the Chief Engineer of the Water Department, formed a commission of experts, to whom was referred the entire subject of the present and future water supply of the City of Philadelphia.

Mr. Fairman Rogers declining, by the unanimous recommendation of the remaining appointees, Col. Julius W. Adams of Brooklyn, was appointed in his place.

The following is a synopsis of their deliberations, recommendations, etc.

Theoretical capacity of the present works 102,000,000 galls.

Practical working capacity during a full supply of water in the river.

by water-power, 30,000,000; by steam-power, 41,000,000; total, 71,000,000 galls.
Actual capacity during a drought: by water-power, 14,000,000: by steam-power, 41,000,000: total, 55,000,000 galls.
Minimum flow of the Schuylkill, 245,000,000 galls.

PLANS FOR PERMANENT WATER SUPPLY.

1875.—By conduit from the Delaware at Belvidere, 90 miles, at an estimated cost of 5, 4, or $300,000 per mile.
By pumping and conduit from New Hope for 75,000,000 galls. daily: cost, $23,000,000.
By the New Hope canal and conduit; cost, $22,500,000.
By the Scudder's Falls canal and conduit: cost, $21,500,000.
By gravity supply from the Perkiomen:
For a daily supply of 100,000,000 galls., cost $10,000,000
For a daily supply of 200,000,000 galls., cost...... .... $12,000,000

RECOMMENDATIONS FOR THE PRESENT AND FUTURE SUPPLY OF THE CITY.

1875.—The completion of the East Park Reservoir, and connecting it by 48-in. pumping mains with the works at Spring Garden and Fairmont, and by distributing mains of the same size with the Spring Garden, Corinthian and Delaware Reservoirs.
That the six large turbines at Fairmount be altered so as to operate more economically: estimated cost, about $16,000.
The construction of two new turbines, in place of the old breast wheels Nos. 2 and 6: estimated cost, $70,000.
The erection of a pumping engine of 10,000,000 galls. capacity at the Spring Garden Works.
Re-arranging the pumping mains at the Belmont Works and putting in a proper distributing main from Belmont Reservoir to supply the east side of the river.
The building of an intercepting sewer on the east side of Fairmont pool, or of a conduit for purer water from Flat Rock dam to the pumping works at Belmont, Spring Garden and Fairmount.
The extension of the inlet pipe at the Kensington Works into deeper water.
The raising of the Delaware Reservoir six feet.
The establishment of a new pumping station at Lardner's Point, with a reservor at or near Wentz Farm, with proper mains connecting the pumping works with the Delaware Reservoir, and with the new reservoir supplying Frankford, etc.
The consideration of the purchase and use of water-power at Manayunk, and the construction of the proposed new works dependent thereon.
Paper by Julius W. Adams, C. E., on the pollution of rivers as applicable to the future water supply of the City of Philadelphia.
Chemical examination of the waters of the Schuylkill and Delaware Rivers, by Messrs. Booth and Garrett.
Chemical examination of the waters of the Schuylkill and Delaware Rivers by Charles M. Cresson, M. D.
Report of James F. Smith on the flow of the Schuylkill River, and the means of increasing the power for pumping water by impounding reservoirs.
Estimates for a gravity supply from the Perkiomen, by Wm. J. McAlpine.
September, 1875.—The springs at Chestnut Hill failed, and a main was laid from Mount Airy Reservoir a distance of 5,772 feet for its supply.

STATISTICS RELATING TO FAIRMOUNT WATER-WORKS PREVIOUS TO CONSOLIDATION.

Year.		Revenue	Expenditures.	Ft. of wood pipe laid.	Fr. of iron pipe laid.	Av. dy. supply in galls.	No. of consumers.	Number of galls. per tap per day.
1801	Per duplicate	$278	....	7,000	....	....	34	....
1802		538	....	29 963	....	....	152	....
1803		961	$295,352	18,000	....	....	267	....
1804		1,800	34,218	30,472	3,978	....	345	....
1805		3 260	41,168	28,200	....	....	685	....
1806		5,050	57,623	12,000	....	....	1,166	....
1807		4,987	26,165	2,000	....	....	1,181	....
1808		6,207	24,630	2,164	....	....	1,284	....
1809		9,105	29,467	5,630	....	....	1,590	....
1810		10,932	26,906	7,891	....	....	1,922	....
1811		12,163	29,702	5,015	....	....	2,127	....
1812		15,629	27 947	6,718	....	....	2,396	....
1813		16,638	30,360	7,426	....	....	2,637	....
1814		17,883	33,866	4,441	....	968,383	2,850	340
1815		18 499	183,290	9 395	....	1,025,455	2,983	344
1816		16,975	51,220	14,410	....	....	3,227	....
1817		19,922	51,389	6,399	400	1,073,905	3,248	331
1818		21.121	34,771	3,785	....	....	3,488	....
1819		21.999	119,064	3.000	....	....	3,847	....
1820		23,017	149,701	3,588	9,570	....	4,170	....
1821		24,585	115,746	5,803	8 475	....	4,590	....
1822		25,486	106,518	3,397	16,035	....	4,758	....
1823	Paid into City Treasury	26,013	69,269	3,754	14,993	1,972,975	4.844	407
1824		26,574	82,209	3,072	20,500	1.798,452	5,061	355
1825		27,299	44,307	5.895	11,394	1,563.452	5,470	286
1826		29,765	73,517	4,913	27,496	1,709,091	5,879	291
1827		37 558	86,750	2.197	41,044	1,633,844	6,204	264
1828		46,476	64,151	2,275	23.285	2,045.801	6,775	302
1829		52.313	81,186	600	16,868	2 197,647	9,633	228
1830		68.918	35,661	850	26,675	2,466.096	10,143	243
1831		65,695	63,010	1,131	15,630	2,954,283	11,386	259
1832		73,020	65,196	220	16,296	3,662,582	11,646	314
1833		79,437	37,354	....	9.497	4.014.044	13 472	298
1834		85.258	65,163	....	13.597	4,150,771	14.204	292
1835		92,117	73,288	....	17,637	4,107,464	18,704	220
1836		101.266	71.707	....	17.283	4,178,317	19,674	212
1837		105,871	49,730	....	8,050	4,219,481	20,462	206
1838		109,826	50,642	....	11,803	4,700,790	21,947	214
1839		121,100	24,742	....	5,255	4,856,696	22,636	215
1840		126,075	22,452	....	2,618	4,925,402	23,482	210
1841		134,635	24,702	....	1,865	5 427,133	24,828	219
1842		139,683	63.911	....	3,083	5,246 274	25.816	203
1843		144,766	63.172	....	5,373	5,398,774	26,549	203
1844		151,501	29,713	....	6,618	6,507,309	28,082	232
1845		92,227	25 892	....	5,520	5,026,631	20,165	249
1846		100,200	50,771	....	15,421	4,264 137	21,551	198
1847		110,505	34,316	....	9,279	4,975.508	22,789	218
1848		117,976	49.580	....	17,781	5,219,505	24,230	216
1849		125,511	84,577	....	11,342	5.397,297	25,670	210
1850		132,592	131,826	....	22,253	5,841.841	27,550	212
1851		140,314	92,380	....	7,867	6,947,142	29,014	239
1852		151,323	72,347	....	12,620	6,997,194	30,592	229
1853		163,071	43.511	....	5,180	7,607,157	32,300	235
1854		175,466	66,502	....	3,372	11,700,786	......	....
Total		$3,434,382	$3,356,627	241,604	465,953			

The pipes laid in 1804 and 1817 were taken up, and should be deducted from the above amount.

REFERENCES.

Under this head we first and properly mention the "History of the Water Supply of Philadelphia," given in the Department Report for '75. This has been of great service in preparing our Historical Description, as it is very complete and well arranged, especially in its account of the works from '01 to '54. The dates of the important events, given above, are taken from this source.

"The Early Water Supply of Philadelphia." Being extracts from a *Report of the Committee for the Introduction of Wholesome Water into the city of Philadelphia,* 1801. By Rudolph Hering. Read Nov. 7, '85. Proc. Engrs. Club of Phila., vol V., pp. 268-72.

"Notes upon the Early History of the Employment of Water-Power for Supplying the City with Water, and the Building and Rebuilding of the Dam at Fairmount. With three sheets of cuts showing old and new plans for the dam. By Frederick Graff. Read May 1, '86. Proc. Engrs. Club of Phila., vol. V., pp. 372 8,

"Fire Hydrants." With a page of cuts showing the first hydrants used in Philadelphia. By Frederick Graff. Read Dec. 1, '83. Proc. Engrs. Club of Phila., vol. IV., pp. 26-36.

"Wooden Water-Pipes." Remarks made May 3, '84, regarding pieces of wooden pipe found in Philadelphia and believed to have been laid between 1795 and 1805. The method of joining the ends is described. By C. Henry Roney. Proc. Engrs. Club of Phila., vol. IV., p. 114.

"Chemical Obstructions in Iron Water Pipes." With a colored illustration showing a 2-in. service pipe obstructed with sesquioxide of iron and sedimentary matters. By Col. Wm. Ludlow. Read Feb. 2, '84. Proc. Engrs. Club. of Phila., vol. IV., pp. 65-6.

" A Peculiar Case of Failure in a Water Main." With cut. A hole 1 by ½ in. scoured through a 4-in. cast-iron pipe. ⅜-in. thick, by a jet of water from a defective joint. By D. McN. Stauffer. Read Dec. 5, '77. Trans. Am. Soc. C. E., vol. VII., pp. 14 16.

"The Water Supply of Philadelphia." With a topographical map of the city. and six tables. Relates to a proposed gravity supply from the Perkiomen valley, By Chas. C. Darrach. Read May 3, '79. Proc. Engrs. Club of Phila., vol. I., pp. 162-75.

"Recent Stream Gauging for the Future Supply of Philadelphia." Remarks made Apr. 17, '86, upon the gauging of eight streams. By H. W. Sanborn. Proc. Engrs. Club, Phila., vol. V., pp. 413-15.

"The Pollution of the Upper Schuylkill." By Dana C. Barber. Remarks and discussion, May 16, '85. Proc. Engrs. Club of Phila., vol. V., pp. 159-60.

"Removal and Rebuilding a Stand-Pipe," from the West Philadelphia to the Spring Garden works. By W. Bugbee. Description given Nov. 15, '84. Proc. Engrs. Club of Phila., vol. V., p. 72.

"The Means Employed in Repairing Belmont Submerged Main at Philadelphia." With plate of cuts showing balanced floating coffer-dam used in the operation. By J. J. De Kinder. Read Oct. 18, '84. Proc. Engrs. Club of Phila., vol. IV., pp. 232-9.

The following references are to volumes and pages of the *Engineering News*;

Additional Supply	11	248
Analysis of	14	46
Causes for Bad Quality in '83	10	342
Chief Engineership of Dept	15	25
Col. Ludlow and Councils	13	232
Contracts	10	483
Cost of Pumping	5	86
Dangers from	13	222
Department	6	172
	9	438
	10	9 26
	11	258 260
Early supply of	15	237
Early Am. Pumping Plant	17	246-8 262
Extensions	15	358
Future Supply	5	226-9
	7	361
	9	368 438
Four Pamphlets on	7	103 121
Report on Additional	9	364
R. Hering's Appointment	10	234
Preliminary Report of Survey	10	498
Col. Ludlow to the Franklin Institute	14	24
History by J. J. R. Croes	8	102 112
Increase of Consumption	14	93
Machinery	10	262 275

Pollution of	9	241 254
	12	162
	13	94
Public Buildings Supply	13	232
	14	61
Reports of	5	265
1884	14	217
84th	16	133
Schuylkill Storage and Power Co	13	94
South Mountain	12	311
	14	270 269
	15	188
Supply, General	5	176
	6	263
	9	368
	9	414 424
	10	314
	11	138
	12	21
	14	204
Tables of op. exp., '61-81	9	368
Wells in Philadelphia	13	222
Wentz Farm Reservoir	8	123

PHILLIPSBURGH, *Centre Co.* (Pop., 1,779; est., 3,000.) Engaged in lumbering and coal mining, and in manufacturing flour, leather, sash and doors.

History.—Built in '81 by Phillipsburgh Water Co.

Water Supply.—Mountain stream, pumping to reservoir.

Pumping Machinery.—Dy. cap., 600,000 galls.; W. P. Duncan & Co.'s plunger pump, and Erie City engine and boiler.

Reservoir.—Cap., 300,000 galls.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 400. *Meters*, none. *Hydrants*, W. P. Duncan & Co.'s, 44.

Consumption, 300,000 galls. *Pressure*: Ordinary, 55 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000. No debt. Ann. op. exp., $2,400. Ann. rev.: consumers, $6,000; city, $660 for hydrants, or $15 each.

Management.—Prest., J. N. Casanova. Secy., Wm. E. Irwin. Supt., Henry Southard.

PHŒNIXVILLE, *Chester Co.* (Pop., 6,682; est., 7,500.) On west bank of Schuylkill river, at the mouth of French creek which flows through the middle of the town; is 27 miles from Philadelphia. Manufactures iron, iron bridge material, machinery, bricks, pottery, needles, shirts and stockings, and has silk factories and planing mills.

History.—Built in '72-3 by borough. Engr., Isaac S. Cassin, Philadelphia. Contrs., Real & McTate. Sub.-Contrs., Richard Denithorne, Phœnixville. In '80 the Phœnix Iron Co. built works for supplying their shops.

Water Supply.—Schuylkill river, pumping to reservoir.

Pumping Machinery.—Worthington duplex, dy. cap., 600,000 galls.; has 34 and 24-in. steam, and 12 and 14-in. water cylinders, and lifts water 195 ft.

Reservoir.—Cap., 2,520,596 galls.; in excavation and embankment, lined with brick in cement on 18 in. of clay puddle.

Distribution.—*Mains*, c. i., 4 to 16-in., 12.04 miles. *Services*, lead. Pipes and specials furnished by Mellert Foundry & Machine Co., Reading, and pipe laid by W. T. Wilkinson, Phœnixville. *Taps*, (in '85,) 802; not given for '88. *Meters*, 4. *Hydrants*, Mathews, (in '85,) 126; not given for '88. *Valves*, Ludlow.

Consumption, 500 000 galls. *Pressure*: Ordinary, 65 to 75 lbs. Fire, do.

Financial.—Cost, based on bonds issued, $397,000. Present bonded debt, $192,200. Int., 4.7%. Ann. op. exp., $13,169. Ann. rev.: total, $15,872.

Management.—Comm. of three. Supt., A. S. Vanderslice.

PITTSBURGH, *Allegheny Co.* (Pop., 156,389; est., 215,000.) At junction of Allegheny and Monongahela rivers, forming the Ohio. Allegheny City is across the river. Along the river banks a narrow strip of land with an area of 5.16 sq. m. rises 120 ft. above the river, and comprises the business part of the city. Of the remainder of the city 8.61 sq. m. rises 120 to 250 ft., 7.06 sq. m. rises 250 to 400 ft., and two summits rise 520 ft. above the river. A steep hillside on the south side of the Monongahela river is also within the city limits. In iron and coal region, having extensive manufactories, especially iron. The Ohio river is navigable to this point, giving river commerce. Occupied as an English military post in 1754, settled as a village in 1758, and incorp. a city in '16.

History.—Built in '26 by city; new works built in '42-4, and in '72-8. Engrs.: of works built in '44, R. Moore; of works built in '78, E. S. Chesbrough and Moses Lane.

The population in '26 was about 12,000, and Feb. 24 an ordinance was introduced in the councils providing for a loan to construct water-works. This was ratified by a nearly unanimous vote of the citizens. A water committee was appointed from the councils to supervise the work, and money was loaned the city by the Pittsburgh and the Exchange banks. The site for the engine house cost $1,425, and for the reservoir, $3,800. The former was located at the corner of Duquesne Way and Cecil Alley; the latter at what was afterwards the site of the court house burnt about '82, and was a lot 240 ft. sq. In '29 the revenue from the works was $3,086. For the first three years the consumption was but 4,000 galls. a day.

The second works were put in operation July 4, '44, at which time the consumption did not exceed 1,000,000 galls. a day, although 9,000,000 galls. pumping capacity was provided.

Water Supply.—Allegheny river, pumping to reservoirs. The new supply in '78 was taken at Negley's on the river, about 10 miles above the lowest point of the city.

Pumping Machinery.—Combined dy. cap., 50,000,000 galls.: graduating plunger double cylinder pumping engines.

The first pump had a dy. cap. of 1,500,000 galls., and the two erected in '44, of 9,000,000 galls. In '45 two engines were placed at the Bedford Avenue reservoir to lift water to the old high service reservoir. Horizontal noncondensing engines, with 15-in. cylinders, driving 11 in. pumps, all of 72-in. stroke. In '69 a Lowry engine was added, having 26-in. cylinders of 96-in. stroke, and working two 18¾-in. pumps of 72 in. stroke.

At the works built in '78 four engines with 64-in. cylinders of 168 in. stroke each work two 40-in. plunger pumps of 135-in. stroke, and lift water 335 ft. to the Hiland reservoir.

Reservoirs.—Combined cap., 120,000,000 galls. *Bedford Avenue*: Is 135 ft. above the river. *High Service*; Is 398 ft. above the river. A vein of coal extends below the reservoir, 4 ft. thick and its top 10 ft. from the reservoir bottom. It took fire, and was burning slowly toward the reservoir, when, in '79, a trench was dug as near the fire as possible and kept filled with water until the fire was extinguished.

Distribution.—*Mains*, c. i., about 175 miles. *Services*, lead. *Taps*, about 16,000. *Meters*, 27. *Hydrants*, kind not given, 1,200.

Consumption, 30,000,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $4,500,000. Bonded debt, $4,500,000, due in 5 to 10 years. Int., 6 and 7%. Ann. op. exp., $198,000. Ann. rev.: consumers, $510,000; city, none.

Management.—Supt., Geo. H. Brown. Report for '88 made Geo. Sheppard.

References.—*Engineering News*, vol. VI., p. 62, relating to pumping engines; vol. VI., p. 271, Hiland reservoir; vol. VI., p. 359 break of air chamber of pumps; vol. XII., p. 250, early history; XIX., p. 547, wells.

PITTSTON, *Luzerne Co.* (Pop., 7,472; est., 12,000.) On Susquehanna river at head of Wyoming Valley, 8 miles from Wilksbarre and 9 miles from Scranton. On broken and hilly ground, the business part of the town lying along the river. Has extensive coal mines and a number of manufactories. Settled in 1776; incorp. a borough in '53.

History.—Built in '56-7 by Pittston Water Co., who also supply West Pittston

Water Supply.—Susquehanna river, pumping to reservoirs.

Pumping Machinery.—Combined dy. cap., 3,000,000 galls.; 2,000,000 gall. Worthington compound duplex pump erected in '77, and 1,000,000-gall. Knowles double-acting plunger pump erected in '82. The first pump was a rotary, but did not work well.

Reservoirs.—Combined cap., 2,500,000 galls.; two, in excavation and embankment, one holding 2,000,000 galls. at 166 ft. above pumps; one holding 500,000 galls. at 191 ft. above pumps.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. *Taps*, est., 1,900. *Meters*, *Hydrants*, Mathews, principally, 28. *Valves*, Eddy, mostly.

Consumption, 1,100,000 galls. *Pressure*: Ordinary, 40, lbs. Fire 40 lbs.

Financial.—Cost, $114,000. Capital stock, $76,400. No debt. Ann. op. exp., $8,000. Ann. rev.: consumers, about $28,000; city, 350. Hydrant rental, $12.50.

Management.—Prest., Alex. Craig. Secy., A. A. Bryden. Treas., A. L. Bryden.

PLYMOUTH, *Luzerne Co.* (Pop., 6,065; est., 10,000.) On Susquehanna river at lower end of Wyoming valley and at foot of Shawnee or Plymouth mountain, In coal region.

History.—Built in '75-6 by Plymouth Water Co. Engr., Jas. H. Brown. Contr., A. H. Coon, Kingston, Pa.

Water Supply.—Surface water and springs, by gravity from impounding reservoirs; artesian wells and Susquehanna river, pumping to reservoir, the latter in dry seasons. The impounding reservoirs are on a stream having a drainage area of 2½ sq. m. The well is 1,959 ft. deep and in '86 yielded 15,000 to 20,000 galls., or, by pumping, 150,000 galls. a day.

Reservoirs and Dams.—Combined cap., 9,300,000 galls: No. 1 acts as a receiving and distributing reservoir for all the sources of supply, is formed by a dam of cut stone, is 265 above the borough, and has a cap., of 300,000 galls. Nos. 2, 3 and 4 have cap. of 1,500,000, 2,500,000 and 5,000,000 galls., respectively, the dam of No. 2 being of ctut stone, and those for Nos. 3 and 4 of stone backed with earth.

Pumping Machinery.—Dy. cap., 400,000 galls.: two Griscom pumps, each of 12-in. steam cylinders, with two 6½-in. plungers, all of 36-in. stroke. There has been a Knowles pump at the well, but no mention of it is made in the report for '88. It had a 14-in. steam cylinder, 8½-in. plunger and 48-in. stroke.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. w. i. *Taps*, 900. *Meters*, 4. *Hydrants*, Bailey, said to be 400. *Valves*, Eddy.

Consumption, 600,000 galls. *Pressure*: Ordinary, 120 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Capital stock, $100,000. No debt. Ann. op. exp., $4,000. Ann. rev.: consumers, $14,100; city, $900. Hydrant rental, $7.20.

Management.—Prest., Draper Smith. Secy., J. W. Chamberlain. Supt. and Treas., O. M. Lance.

PORT CARBON, *Schuylkill Co.* (Pop., 2,346; est., 3,000.) Near, and supplied from, Pottsville, which see.

POTTSTOWN, *Montgomery Co.* (Pop., 5,305; est., 12,000.) On Schuylkil, river. Engaged in manufacturing nails, boiler plate and ship iron, iron bridges, boilers, steel ingots, machinery, agricultural implements and cigars. Settled in 1730; incorp. a city in '12.

History.—Built in '69-71 by Pottstown Gas & Water Co. Engr., Isaac S. Cassin, Philadelphia. Work done by the day under direction of Co.

Water Supply.—Schuylkill river, pumping to reservoir.

Pumping Machinery.—Combined dy. cap., 2,500,000 galls.; 1,000,000-gall. Worthington pump and 1,500,000-gall. pump made by Philadelphia Hydraulic Works. Two return tubular boilers, each 5 by 22 ft.

Reservoir.—Cap., 1,500,000 galls, at depth of 17 ft. Is 140 ft. above river, and 100 ft. above town.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead, w. i. Pipe and specials furnished by Mellert & Kinsley, Reading, and pipe laid by Jno. Worthington, Philadelphia. *Taps*, about 1,200. *Meters*, 6. *Hydrants*, Kinsley, Mellert, Chester, about 120. *Valves*, kind, do.

Consumption, 450,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $125,000. Capital stock, $50,000. Bonded debt, $10,000. Int., 4½%. Ann. op. exp., withheld. Ann. rev.: withheld. Hydrant rental, none.

Management.—Prest., Isaac Fegely. Secy. and Treas., J. H. Maxwell. Supt., Hiram Royer.

POTTSVILLE, *Schuylkill Co.* (Pop., 13,253; est., 15,000. Est. pop. supplied, 25,000.) On Schuylkill river, on hilly ground rising 200 ft. from the river. Engaged in mining and shipping coal. Settled in 1800; incorp. a borough in '31.

History.—Built in '34-6 and extended in '54 and '75 by Pottsville Water Co., who also supply Palo Alto, Port Carbon and St. Clair.

Water Supply.—Mountain streams, by gravity from impounding to distributing reservoirs. The first supply was from a spring. In '54 water was brought by gravity from Wolfe run through to a distributing reservoir in the town. In '75 a storage reservoir was built on Eisenhuth run.

Reservoirs.—Combined cap., 450,000,000 galls. *Distributing*: Cap., 5,000,000 galls.; filled through a 12-main 4 miles long. *Eisenhuth*: Cap., 300,000,000 galls.; covers 70 acres, and is 600 ft. above town, with which it is connected by a 12-in. cast-iron pipe. There is another storage reservoir, with a cap. of about 150,000,000 galls., but no description of it is given.

Eisenhuth Dam—Of earth, 1,350 ft. long, 35 ft. high, 40 ft. wide on top, with slopes of 2 and 2½ to 1.

Distribution.—*Mains*, c. i., 36 miles. *Services*, lead. *Taps*, withheld. *Meters*, none. *Hydrants*, kind and number withheld. *Valves*, withheld.

Consumption, withheld. *Pressure*: 80 to 100 lbs.

Financial.—Cost, withheld. Capital stock, $200,000. Bonded debt, $69,000. Int., not given. Ann. op. exp., withheld. Ann. rev.: consumers, withheld: city, none in '83.

Management.—Prest., D. W. Bland. Secy. and Engr., W. D. Pollard.

PUNXSUTAWNEY, *Jefferson Co.* (Pop., 674; est., 1,500.) On Mahoning creek in mining, grazing and agricultural district. Has lumber trade.

History.—Built in '87 by Punxsutawney Water Co. Engr. and Contr., R. B. Thomas Clarion.

Water Supply.—Mahoning creek, pumping to tank.

Pumping Machinery.—Dy. cap., 312,000 galls.; direct-acting Epping pump, and boiler from Monroe & Co., Pittsburgh.

Tanks.—Combined cap., 78,000 galls.; two tanks furnished by Alex. Watson, Bradford.

Distribution.—*Mains*, 6 and 4-in. c. i., 3 miles. *Services*, lead. Pipe furnished by R. D. Wood & Co., Philadelphia. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 13. *Valves*, and other material, Epping, Carpenter & Co., Pittsburgh, Mueller Mfg. Co., Decatur, Ill.

Consumption, 70,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $15,000. Capital stock, $15,000. Debt, $1,500. No bonds. Int., 6%. Ann. op. exp., $1,050. Ann. rev.: consumers, $1,600; city, $195. Hydrant rental, $15.

Management.—Prest., H. F. Fishman. Secy., H. G. Miller. Treas., L. Pantall. Supt., Chas. E. Ratz.

READING, *Berks Co.* (Pop., 43,278; est., 60,000.) On Schuylkill river. Has various manufactories.

History.—Built in '19-21 by Reading Water Co., and purchase in '65 by city.

The Co. was incorp. by Act of Assembly, Mar. 16, '19, the Commissioners named being Jno Spayd, Frederick Heller, Jno. Adams, Geo. de B. Keim and Jno. Birkinbine. The Co. bought the Hampden spring and land surrounding it, which was then northeast of Reading, but is now within the city limits. A reservoir was built at the head of Penn street and water conveyed to it from the spring through 1.05 miles of 2½-in. pipes, some earthern, and some wooden logs. July 19, '21, water was let into the reservoir and in the following October distributed through the town. The reservoir had a cap. of "one thousand hogsheads," or about 600,000 galls., and the spring had a daily flow of 100,000 galls. The distributing pipes were principally of iron 2 to 4 in. in diam. In '33 over $20,000 had been expended on the works, 250 families were supplied, the annual income was $1,500 and the population of the town was about 6,500. There is no record of Des. Engr., but Mark B. Scull was Supt. of the Co. for the last 20 years of its existence. April 1, '65, the Reading Water Co. sold its works and franchises to the city of Reading for $300,000.

Water Supply.—Hamden, Mineral and Edelman springs. Bernhart and Antietam creeks, by gravity. The creeks flow through sandstone formation, and there is an impounding reservoir on each, and three distributing reservoirs. The drainage area and minimum daily flow of each of the sources of supply is: Hampden spring, ¼ sq. m. and 80,000 galls.; Mineral spring, ½ sq. m. and 120,000; Edelman spring, ¼ sq. m. and 50,000 galls.: Bernhart creek, 2½ sq. m. and 600,000 galls.; Antietam creek, 4½ sq. m. and 950,000 galls. Total drainage area, 8 sq. m.; total minimum daily flow 1,800,000 galls. The present av. dy. consumption is 4,000,000, and there is much talk of an additional supply.

Reservoirs.—Combined cap., 154,250,000 galls., or 38½ days storage for av. dy. consumption of 4,000,000 galls.

City Reservoirs.—Combined cap., 6,250,000 galls.: northern basin, 2,750,000; southern, 3,500,000 galls. Built by Reading Water Co.. the first in '21, the second in '48, and enlarged by city '72 at an expense of $16,869. Engr. for latter work, E. F. Smith. Contr., Owen O'Reilly.

Bernhart Reservoir.—Cap., 41,000,000 galls. The original reservoir was formed by a dam built by Reading Water Co. in '58. This was abandoned in '69 upon the completion of a new reservoir, formed by a much larger dam, built by the city in 69, and having a cap. of 20,000 000 galls.

In '86 the reservoir was enlarged to its present capacity. Engr. for work in '69 and '86, E. F. Smith, Contr. for work. in '69, Owen O'Reilly; for work in '86, E. J. Nolan, Cost of work done in '69, about $18,500; of work in '86, $17 225. Total cost of present Bernhart dam and reservoir, about $36,000.

Antietam Reservoir or Lake.—Cap., 80,000,000 galls. Built in '80-1, with H. P. M. Birkinbine as Engr., and Christian Eben, Contr. Cost of dam and reservoir, $49,595; of damages to mills and riparian owners, $107,888. Total, $157,483. The dam forming the reservoir is 3½ miles northeast of the city, and water is conveyed from it to the city reservoirs through 16 and 20-in. pipes, laid 1,700 ft, in a tunnel.

Hampden Reservoir.—Cap.. 27,000,000 galls. Built in '82-3 with City Engr. A. Harvey Tyson, in charge; Nolan Bros. were Contrs. for reservoir, and Hoskin & Guiles for sodding same. Total cost $136,557, of which $13,106 was paid for sodding.

Tunnel.—On line of 16 and 20-in. mains from Antietam impounding to City distributing reservoir, 1,700 ft, long.

Distribution.—*Mains*, 4 to 20-in. c. i., 58.9 miles. *Services*, w. i., lead. *Taps*, 21,940. *Meters*, 11. *Hydrants*, Adams, Tamaqua, 379. *Valves*, Douglas & Connard, Reading.

Consumption, 4,000,000 galls. *Pressure*: 35 to 65 lbs., according to elevation.

Financial.—Cost, $1,166,405. Bonded debt, $470,500: $182,500 at 5%, $83,000 at 4% and $205,000 at 6%, Sinking fund, $38,755. Ann. op. exp., $14,580. Ann. rev.: consumers, $83,962; city, none.

Management.—Four Commrs.: F. S. Jacobs, Prest., James Rick, Jacob Hell, A. A. Heizmann. Clerk, Geo. H. Felix. Supt., Wm. B. Harper. We are indebted to E. F. Smith, 516 Franklin street, Reading, for the data given above.

RENOVO, *Clinton Co.* (Pop., 3,708: est., 4,500.) On West branch of Susquehanna river, in a mountainous region. Center of mining and lumber region, and has railroad machine shops. Settled in '63; incorp. a city in '67.

History.—Built in '72-3 by city. Des. Engr., — Welsh. Const. Engr., Pharon Jarrett, deceased, Contrs. Scheid & Jarrett, Lock Haven.

Water Supply.—Peters' run, by gravity, with pumping when water is low.

Pumping Machinery.—Not given.

Reservoirs.—Cap., 2,000,000 galls.; formed by dam across stream ¾ miles from and 150 ft. above city, and covers about an acre. There has been a tank in connection with the works, but it is not stated whether this is now in use.

Distribution.—*Mains*, w. i., and cement, 5 miles. *Services*, w. i. *Taps*, 475. *Meters*, none. *Hydrants*, kind not given, 62.

Consumption, not given. *Pressure*: 150 ft. head.

Financial.—Cost, $57,000, Debt, $46,359. Int., 4 and 4½%. Ann. op. exp., $125. Ann. rev.: consumers, $2,850; city, none.

Management.—Supt., H. English.

REYNOLDSVILLE, *Jefferson Co.* (Pop., 1,410; est., 2,500.) In bituminous coal region, and is engaged in mining, lumbering, milling, and making coke.

History.—Being built in '88 by Reynoldsville Water Co. Contr., R. B. Thomas, Clarion. No further data given. See Supplement.

RIDGWAY, *Elk Co.* (Pop., 1,100; est., 2,500.) On Clarion river. Engaged in tanning, and lumber trade.

History.—Begun Sept., '88, and to be finished about Dec. 1, '88. Engr., Horace Little. Work being done by city.

Water Supply.—Mountain streams, one to three miles distant, by gravity.

Reservoir.—Not described.

Distribution.—*Mains*, 8, 6 and 4-in., about 5 miles. Pipe and specials furnished by National Foundry & Pipe Works, limited, Scottdale, Pa. *Services*, not given. *Taps* and *Meters*, not determined. *Hydrants*, R. D. Wood & Co.'s, 20. *Valves*, Kennedy's.

Consumption and *Pressure*, not determined.

Financial.—Cost, $16,000 to $20,000. Bonded debt, $16,500. Int., 4%. Ann. op. exp., and ann. rev., not determined.

Management.—Secy. of Borough Council, W. C. Healy.

SAINT CLAIR, *Schuylkill Co.* (Pop., 4,149; est., 5,000.) On Mill creek, 3 miles from Pottsville, which see.

SAINT PETERSBURGH, *Clarion Co.* (Pop., 1,044; est., same.)

History.—Built about '75 by borough. Engr. and Contr., Daniel Whitling, St. Petersburgh.

Water Supply.—Spring, 3 miles distant, by gravity. Originally a Knowles pump lifted water from a well, but this supply has been abandoned.

Tanks.—Three, combined cap., 117,000.

Distribution.—*Mains*, 4-in., material not given, about 3 miles. *Services*, ¾-in., material not given. *Taps*, 250. *Meters*, not given. *Hydrants*, Cameron, 15.

Consumption, about 20,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $10,000. No debt. Ann. op. exp., $250. Ann. rev.: consumers, $300; city, none.

Management.—Comm. of three: Jos. Krischner, C. O. Drive, and Supt., Josiah Fillman.

SAYRE and ATHENS, *Bradford Co.* (Pop.: Sayre, 729; est., 3,000. Athens, 1,592; est., 3,000.) Villages about one mile apart on a plain lying between Chemung and Susquehanna rivers, a short distance above their junction. Athens has large bridge works, and Sayre has shops of the Lehigh Valley R. R. Athens was settled in 1790, and Sayre in '75.

History.—Built in '84 by Sayre Water Co. Engr., C. W. Knight, Rome. All save pipe laying and accompanying work was done by the Co.

Water Supply.—Susquehanna river, pumping to reservoir.

Intake Pipe.—From a masonry chamber in the river 129 ft. of 20 in. cast-iron pipe extends to the shore, thence to a pump-well 8 ft. in diam. and 32 ft. deep, the bottom of the well being 7 ft. below low water. From this well a 14-in. suction pipe connects with the pumps.

Engine House.—Of brick, 32 by 56 ft., with a chimney 6 ft. sq. at the base and 60 ft. high.

Pumping Machinery.—Dy. cap., 1,500,000 galls. A Worthington compound condensing pump, and two boilers 13 ft. long and 54 in. in diam. made at S. P. & N. Y. R. R. shops.

Reservoir.—Cap., 3,000,000 galls.; in excavation and embankment, in two compartments, the surface being 191 ft. above Sayre, 200 ft. above Athens, and 222 ft. above low water in the river. The two compartments are equal, rectangular, with rounded corners, the greatest depth of water being 13½ ft. The banks rise 4 ft. above the flow line, have inner slopes of 1½ to 1 and outer of 2 to 1. The compartment first finished has its bottom, and slopes to within 2½ ft. of flow line, covered 6 in. of concrete on 6 in. of puddle. Above the concrete the slopes have a heavy wall of stone in cement extending to within 1½ ft. of flow line, then a dry stone wall carried 1 ft. above the flow line, and the slope is finished with broken stone. The second basin is not described. A 20-in. pipe connects the two basins, and by valves in the gate-house either or both reservoirs can be used, or water pumped to one and drawn from the other. The pumping station and reservoir are both on the east side of river, opposite the villages, necessitating a pipe for 700 ft. beneath the river. A 10-in. pipe was laid to Sayre and from this an 8-in. pipe to Athens.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. All pipe for the original works above 6-in. was furnished by R. D. Wood & Co., Philadelphia, and all below, by the Sayre Pipe Foundry, and pipe laying, setting valves, hydrants and specials by Inman Bros., N. Y. *Taps*, 330. *Meters*, 25. *Hydrants*, Mathews, 46. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 80 lbs.

Financial.—Cost, withheld. No debt. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; cities, $2,300. Hydrant rental, $50.

Management.—Prest. and Supt., Howard Elmer. Secy., Wm. Stevenson.

SCHUYLKILL HAVEN, *Schuylkill Co.* (Pop., 3,052; est., 5,000.) On Schuylkill river, 4 miles south of Pottsville and 31 northwest of Reading. Has railroad shops, rolling mill, soap factory and boat yards.

History.—Built in '84-5 by Schuylkill Haven Gas & Water Co. Const. Engr., Ed. McGinley. Contrs., American Construction Co., Philadelphia.

Water Supply.—Springs, four miles from town, by gravity.

Distribution.—*Mains*, 8 to 4-in. c. i., 9 miles. *Services*, galv. i., lead. *Taps*, 300. *Meters*, none. *Hydrants*, Mellert, 26. *Valves*, Mellert.

Consumption, not given. *Pressure*: Ordinary, 135 lbs. Fire, 135 lbs.

Financial.—Cost, $80,000. There are first mortgage bonds on the works, amount not given. Int., 6%. Ann. op. exp., for both gas and water-works, $2,000. Ann. rev.: not given. Hydrant rental, originally $20, but Council has refused to pay anything.

Management.—Prest., Caleb Horn. Secy., Geo. S. Moyer. Treas., Wm. B. Reedy. Supt., W. H. Mellon.

SCRANTON, *Lackawanna Co*, (Pop., 45,850; est., 75,000.) On Lackawanna river, Roaring run and Stafford Meadow brook, in a wide valley. Has extensive works for the manufacture of steel, iron, locomotives and mining machinery. Has large anthracite coal trade. Settled in 1788; incorp. a borough in '56, a city in '66.

THE PROVIDENCE GAS AND WATER CO.

History.—Built in '67-8, and now supplies about 20,000 inhabitants. Des. Engr., E. W. Weston, Scranton. Const. Engr., O. D. Shepherd, Scranton. Work done by Co., without Contrs.

Water Supply.—Storage reservoirs on streams, by gravity.

Reservoirs.—Cap., 450,500,000 galls.; two storage, with cap. of 450,000,000 galls, and one small distributing, cap., 500,000 galls.

Distribution.—*Mains*, 20 miles of tarred iron; three lines, 8, 12 and 20-in., respectively. *Services*, galv. i. *Taps*, 1,324. *Meters*, none. *Hydrants*, Ayers, Eddy, Ludlow, 60. *Valves*, kind, do.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 75 to 120 lbs.

Financial.—Cost, stock, bonds, int., all withheld. Ann. op. exp., $2,000. Ann. rev.: consumers $2,500; city, $1,000 for hydrants, or $16.66 each; 13 years' contract.

Management.—Prest., W. R. Storrs. Secy. and Treas., H. F. Atherton. Supt., J. B. Fish.

SCRANTON GAS AND WATER CO.

History.—Built in '57 and enlarged in '71. The former work was done by Joseph Bottin, and the latter with C. E. Judson as Engr.

Water Supply.—Surface water, by gravity from impounding reservoir, with small reservoir and stand-pipe as equalizers of pressure.

The first supply was pumped from the river, but in '66 this was so contaminated by sulphuric acid from the mines that the source was changed to Roaring run having a drainage area above the dam of 45 sq. m.

The supply introduced in '71 is from a mountain pond 19 miles distant, with an area of 196 acres, a drainage area of 1 sq. m., and a cap. of 300,000,000 galls, and also from Roaring run, the outlet of the pond, there being a storage reservoir on the stream.

Old Storage Reservoir.—Cap., 80,000,000 galls.; formed by dam on stream, is 4½ miles from city, and about 300 ft. above it, and 400 ft. above Lackawanna river.

New Storage Reservoirs.—One built in '87 on Oak run, with Burk Bros., Scranton, Contrs. A larger one is being built in '88 on Roaring run. E. Sherman Gould is Engr. of each.

Old Dam.—At the first Roaring run reservoir, of stone masonry, 320 ft. long, 35 ft. high, 8 ft. wide at top and 22 at bottom, except for 100 ft. of length, which is 35 ft. wide. Up stream face is vertical, and lower face batters 1 in 3. Spillway is of cut stone, stepped, 100 ft. long..

Filter and Supply Pipes.—At old reservoir water passes to two 16-in. cast-iron supply pipes through a filter of sand and gravel.

Distributing Reservoir.—Cap., 1,000,000 galls.; 200 ft. above city.

Stand-Pipe.—Is 4 ft. in diam., with an overflow; height not given.

Distribution.—(In '81.) *Mains*, c. i., 29.3 miles; originally of w. i. and cement. *Services*, galv. i. *Taps*, 1,047. *Meters*, none. *Hydrants*, kind not given, 106.

Consumption, 5,000,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—(In '81.) Cost, for gas and water-works, $680,000. Capital stock, do. $456,000. No debt. Ann. op. exp., withheld. Ann. rev.; consumers, withheld; city, $3,000 for hydrants.

Management.—Prest., W. W. Scranton. Secy. and Treas., Geo. B. Hand. Supt., Robt. Reaves.

NOTE:—Repeated requests for information have been sent to this Co., but none has been given since '81.

SELINS' GROVE, *Snyder Co.* (Pop., 1,431; est., not given.) On Susquehanna river.

History.—Built by Selins' Grove Water-Works Co., date not given.

Water Supply.—By gravity from reservoir filled from stream.

Reservoir.—Not described.

Distribution.—*Hydrants*, 30. No other data given.

Financial.—Not given.

Management.—Address Dr. B. Wagenseller.

SEWICKLEY, *Allegheny Co.* (Pop., 2,053; est., 3,400.) On Ohio river.

History.—Built in '70-1 by borough. Engrs., Edeburn & Cooper.

Water Supply.—Springs, by gravity to and from reservoir, and in dry weather only, pumping from river. Water is conveyed from springs to reservoir by 375 ft. of 15-in. earthenware pipe.

Reservoir.—Cap., 4,000,000 galls.: in excavation and embankment, lined with puddled clay, and having sides paved with brick covered with cement. Is 106 ft. above borough.

Pumping Machinery.—Small Worthington duplex pump and upright boiler.

Distribution.—*Mains*, c. i., 12½ miles. Services, galv. i., lead. *Taps*, about 425. *Meters*, 1. *Hydrants*, Hutchinson & Alexander, 36. *Valves*, kind, do., and Jesse W. Starr & Sons.

Consumption, 100,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 45 lbs.

Financial.—Cost, $95,000. Debt, $75,000: $15,000 at 6%, and $60,000 at 8%. Ann. op. exp., $950. Ann. rev.: consumers, $5,200; city, none.

Management.—Five Commrs. Supt., Jno. Patton, Jr.

SHAMOKIN BOROUOH and COAL TOWNSHIP, *Northumberland Co.* (Pop.: Shamokin, 8,124; est., 1,500. Coal, 4,320; est., 10,000.) Shamokin is on Shamokin creek, in the anthracite coal regions, and Coal is the surrounding township. Shamokin is the P. O. for both places.

History.—The Shamokin Water Co. built works to supply Shamokin in '73, since when the Anthracite Water Co., and the Coal Water Co. have been organized. The three Co.'s are now all under one management and supply both places, the mains of the first Co. being extended at various points into Coal township. The original works were enlarged and their capacity trebled in '86. Const. Engrs., A. B. Cochran Pottsville.

Water Supply.—Springs, by gravity from impounding reservoirs.

Reservoirs.—Combined cap., 41,000,000 galls.: 35,000,000, 5,000,000 and 1,000,000 galls., respectively. The first reservoir built was on Curtis brook, was formed by an earth dam sheet piled and clay puddled, and covered 18 acres. A distributing reservoir was built on the stream a mile below and was formed by a masonry dam. This reservoir covered ¼ acres, was ⅛ mile from and 230 ft. above the borough. No description of the third reservoir has been given.

Distribution.—*Mains*, c. i., 35 miles. *Services*, galv. i. *Taps*, 1,100. *Meters*, 4. *Hydrants*, Mathews, Tamaqua, 43. *Valves*, Some Eddy and Chapman but mostly Ludlow, the latter now used exclusively.

Consumption, 1,000,000 galls. *Pressure*: average, 100 lbs.

Financial.—Cost, $450,000. Debt, $124,000. Int., 4 and 5 %. Ann. op. exp., $5,000. Ann. rev: consumers, withheld; city, $860. Hydrant rental, $20.

Management.—Prest., W. C. McConnell. Treas., C. Q. McWilliams. Secy., Geo. O. Martz.

SHARON, *Mercer Co.* (Pop., 5,634; est., 9,000.) Engaged in coal mining and iron manufacturing.

History.—Built in '85 by Sharon Water-Works Co., Engr., Ellis Morrison, New York City. Contr., Samuel R. Bullock, New York City.

Water Supply.—Chenango river, pumping to reservoir.

Pumping Machinery.—Cap., 2,000,000 galls.; two compound condensing duplex Deane pumps.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i., lead. *Taps*, 398. *Meters*, 4. *Hydrants*, Ludlow, 80. *Valves*, Ludlow.

Consumption, est., 400,000 galls. *Pressure*: Ordinary; 150 lbs. Fire, 150 lbs.

Financial.—Cost, $140,000. Capital stock, $200,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers; $7,150; city, $4,000.

Management.—Prest., Samuel R. Bullock. Secy. and Treas., E. Woltmann. both of 11 Wall street, New York City. Supt., E. J. Robinson.

SHARPSBURGH, *Allegheny Co.* (Pop., 3,466; est., 5,000.) On Allegheny river in coal region, and has furnaces, foundries and rolling mills.

History.—Built in '86 by borough. Engr., Jacob Schallner.

Water Supply.—Allegheny river, by direct pumping.

Pumping Machinery.—Cap., 3,000,000 galls.; two Gordon & Maxwell duplex high-pressure plunger pumps.

Distribution.—*Mains*, c. i., 4 miles. *Services*, not given. Pipe furnished by Buffalo Cast-iron Pipe Co., Buffalo, N. Y. *Taps*, 450. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 400,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $52,000. Bonded debt, $60,000. Int., 5%. Ann. op. exp., $3,000. Ann. rev.: consumers, $5,500.

Management.—Supt., Dan S. Duncan.

SHENANDOAH, *Schuylkill Co.* (Pop., 10,147; est., 18,000.) In anthracite coal region, a number of the largest collieries being within the borough limits.

History.—Built in '70 by Shenandoah Water Co. No Engr. employed and work done by the day.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Covers 10 acres.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead. *Taps*, not given. *Meters*, none. *Hydrants*, kind not given, 41; put in by borough.

Consumption, not given. *Pressure*: 75 to 120 lbs.

Financial.—Cost, $150,000. Capital stock, $50,000. No debt. Ann. op. exp., not given. Ann. rev.: consumers, said to be $700; city, not given.

Management.—Prest., John Cather. Secy., J. O. Roads, Treas., Tom Grant. Supt., S. D. Hess.

SHICKSHINNY, *Luzerne Co.* (Pop., 1,058; est., 2,000.) A mining and railroad center.

History.—Built in '84 by Shickshinny Water Co. No Contr.

Water Supply.—Shickshinny creek, by gravity. Creek is fed by springs.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 60. *Meters*, none. *Hydrants*, 1.

Consumption, unknown. Two railroads, a colliery and a town are supplied. *Pressure*: 70 ft. head, which can be increased to 210 ft.

Financial.—Cost and capital stock, $11,200. No debt. Ann. op. exp., $10. Ann. rev.: consumers, $1,000; city, none.

Management.—Prest., Geo. W. Search. Treas., Jesse Beadle. Supt., M. B. Hughes.

SHIPPENSBURGH, *Cumberland Co.* (Pop., 2,213; est., 2,500.) In grazing and agricultural district.

History.—Built in '86 by borough. Engr., F. H. Thomas, Shippensburgh.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Has a cap. of 700,000 galls., and is 100 by 150 ft.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 39. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 67 lbs. Fire, 80 lbs.

Financial.—Cost, $30,000. Bonded debt, $26,000. Int., 4%. Ann. op. exp., $125. Ann. rev: consumers, $1,400; city, none.

Management.—Supt., B. J. Landis.

SLATINGTON, *Lehigh Co* (Pop., 1,634; est., 2,500.) On Lehigh river, and is divided by Trout creek into upper and lower towns. In slate region. Settled in 50; incorp.a borough in '61.

History.—Built in '61 by private company, and new works built in '83 by borough, with S. D. Lehr, Allentown, as Des. Engr., Jno. D. Emack, Slatington, Const Engr. and Ringer & Kunner, Slatington, Contrs. The company took their supply from springs, collected in a covered reservoir, 40 by 70 ft., and 30 ft. above the upper and 125 ft. above the lower town.

In '81 there were 3 miles of pipe, 150 taps, no hydrants. The capital stock of the company in '81 was $6,000, and the works had cost $10,000. In '80 the expenses were $100 and the receipts $900.

The data below is for the works built by the borough in '83, no mention being made of the company in the report for '88.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Is 10 by 12 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 312. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Consumption, est., 300,000 galls. *Pressure*: said to be 200 lbs.

Financial.—Cost, $26,000. Bonded debt, $26,000. Int., 4%. Ann, op. exp., $100, Ann. rev.: total, $2,400.

Management.—Three Commrs. Prest., L. Williams. Treas., Thos. F. Schiffert. Secy., Geo. McDowell.

SMETHPORT, *McKeon Co.* (Pop., 872; est., 1,200.) In petroleum and mining region.

History.—Built in '81 by Smethport Water Co. Des. Engr., S. V. Godder, Lake George, Fla. Const. Engr., B. D. Hamein, Smethport. Contrs., E. H. Cook & Co., Elmira, N. Y.

Water Supply.—Springs by gravity.

Reservoir.—Has area of 10,000 sq. ft. and average depth of 5 ft.

Distribution.—*Mains*, 6-in. c. i., 3 miles. *Services*, w i., lead. Pipe and specials furnished by Gloucester Iron Works, Philadelphia. *Taps*, about 200. *Meters*, none. *Hydrants*, Philadelphia, 15.

Consumption, unknown. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $18,500. Capital stock, $9,500. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $2,100; city, $300. Hydrant rental, $20.

Management.—Prest., Henry Hamlin, Treas., A. B. Armstrong, who acts as Supt.

SOUTH BETHLEHEM, and WEST BETHLEHEM, *Northampton Co.* (Pop.: So. Bethlehem, 4,925; est., 7,000. West Bethlehem, est., 3,000. Total, est., 10,000.) On Lehigh river. South Bessemer has steel, zinc, brass and boiler works, silk and knitting mills, and deposits of zinc and iron ore.

History.—Built in '85-6 by Bethlehem South Gas & Water Co. No Engr.

Water Supply.— Lehigh river, pumping to reservoir.

Intake Crib and Pipe.—A stone crib is built 60 ft. from the shore, and from this a 20-in. pipe leads to a pump-well.

Pump-Well and Buildings.—The pump-well is 4 by 40 ft., by about 6 ft. deep. The engine house is on a foundation which raises the floor 23 ft. above the river. It is of stone 25 by 45 ft. and 20 ft. high. The boiler house is 38 by 40 ft. and 20 ft. high.

Pumping Machinery.—Dy. Cap., 2,000,000 galls.; vertical compound condensing beam and fly-wheel engine and duplex vertical pumps, made by Dickson Mfg. Co., Scranton. One horizontal tubular boiler.

Reservoir.—Cap., 2,000,000 galls.: in two compartments, separated by a bank 6 ft. wide on top and 70 ft. at bottom. One compartment is 52 by 131 ft. at bottom, with slopes of 2 to 1. The other compartment has about the same cap., but is irregular in shape, and slope of banks. The sides and bottoms are covered with 1 ft. of puddled clay, above which is 1 ft. of concrete. All pipes passing through the banks packed in puddled clay. One compartment is used for a settling basin. A 12-in. pipe crosses the river to West Bethlehem, and a 10-in. pipe leads to South Bethlehem. Contrs., Brown & Goodnow, Bethlehem.

Distribution.—*Mains*, 12½ miles. *Services*, lead. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading, and Donaldson Iron Co., Emaus. Trench ing and pipe laying done by A. H. Coon & Co., Pittston. *Taps*, 550. *Meters*, 1. *Hydrants*, Mathews, Adams, 56. *Valves*, Ross.

Consumption, 600,000 galls. *Pressure*: 85 to 100 lbs.

Financial.—(*Includes both gas and water-works.*) Cost, $147,586. Capital stock, $100,000. †Bonded debt, $34,500. 6% dividends are paid on stock, and 7% on bonds. Ann. op. exp. and rev. not given. Hydrant rental, $15.

Management.—Prest., E. P. Wilbur. Treas., H. S. Goodwin. Supt., B. H. Lehman.

SOUTH EASTON, *Wyoming Co.* (Pop., 4,534; est., 6,200.)

History.—Built in '86-8 by South Easton Water Co. Engr. and Contr., J. Marshall Young, Easton.

Water Supply.—Tunnel, 271 ft. into mountain, by gravity.

Reservoir.—Has cap. of 750,000 galls., and is 100 by 100 ft. Sublet to L. M. Lesher & Son, Easton, for $6,600.

Distribution.—*Mains*, 8, 6 and 4-in. c. i., 5½ miles. *Services*, ¾-in. galv. w. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and pipe laid by L. M. Lesher & Son, Easton. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 20,000 galls. *Pressure*: 45 to 93 lbs.

Financial.—Cost, $32,992. Capital stock, $20,900. Bonded debt, $10,000. Int., 5%. Bonds are now held at 106. Ann. op. exp., not determined. Ann. rev.: consumers, not determined; city, $625. Hydrant rental, $25, a five years' contract.

Management.—Prest., W. F. Pascoe. Treas., Jno. Stewart. Secy., W. B. Salliday. No Supt. appointed.

STROUDSBURG, *Monroe Co.* (Pop., 1,860; est., 2,500.) On Broadhead's creek in agricultural region, and has water-power. Settled in 1799.

History.—Built in '76 by Stroudsburg Water Co., after plans by Dr. J. Albert Cloud.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, 4 and 6-in. c. i., 3 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 14; not used now.

Consumption, unknown. *Pressure*: Ordinary, 57 lbs.

Financial.—Cost, $15,000. Capital stock, $15,000. No debt. Ann. op. exp., $200. Ann. rev.: consumers, $1,500; city, none.

Management.—Prest., Jno. B. Storm. Treas., W. G. Pennypacker. Supt., Frederick Phillips. Report by Jno. S. Brown.

SUMMIT HILL, *Carbon Co.* (Pop., 1,763; est., 2,200.) Engaged in coal mining.

History.—Built in '76 by Summit Hill Water Co. Engr., J. C. Rutter, Lansford.

Water Supply.—Mountain stream, pumping to reservoir 500 ft. above pump.

Pumping Machinery.—Dy. cap., 30,000 galls.; Carter & Allen duplex pump.

Reservoir.—Is 30 by 125 ft., by 10 ft. deep.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 18. *Valves*, Ludlow.

Consumption, not given. *Pressure*: 45 ft. head.

Financial.—Cost, $13,000. Capital stock, $10,000. No debt. Ann. op. exp., (in '84,) $1,300. Ann. rev.: consumers, (in '84,) $2,100; city, not given.

Management.—Prest. and Supt., Saml. Rickert. Secy., Jas. McReady.

SUNBURY, *Northumberland Co.* (Pop., 4,077; est., 7,500.) On Susquehanna river. Has rolling mill, nail works, organ factory, steam saw mills, car and machine shops, coffin, door and sash factories.

History.—Built in '83-4 by Sunbury Water Co.

Water Supply.—Surface and spring water, pumping from impounding to distributing reservoir.

Pumping Machinery.—Cap., 2,000,000 galls.; Two Worthington pumps, and horizontal tubular boiler.

Reservoirs.—*Impounding*: Cap., 700,000 galls.; formed by dam across creek. *Distributing*: Cap., 4,000,000 galls.; in excavation and embankment, 13 ft. deep, the inner slopes and bottom are puddled, then covered with 1 ft. of broken stone. Is one mile from and 131 ft. above town.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 300. *Meters*, 2. *Hydrants*, Mathews, 40. *Valves*, Peet.

Consumption, 400,000 galls. *Pressure*; Ordinary, 56 lbs. Fire, 56 lbs.

Financial.—Cost, $110,000. Capital stock, $33,000. Bonded debt, $77,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $8,000; city, $1,200. Hydrant rental, $30.

Management.—Prest., Jno. Haas. Treas., L. T. Rohebach. Secy. and Supt., S. E. Slaymaker.

SUSQUEHANNA, *Susquehanna Co.* (Pop., 3,467; est., 5,000.) On Susquehanna river, on hilly land. Has repair shops. Settled in '40.

History.—Built in '74 by Susquehanna Water Co.

Water Supply.—Springs, by gravity.

Reservoirs.—Water is taken from a pond 60 ft. in diam., filled by springs, and conveyed by 6-in. c. i. pipe to a reservoir 30 ft. in diam. and 4½ ft. deep, built of round stone laid in cement.

Distribution.—*Mains*, c. i., 0.8 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 5.

Consumption, unknown. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $5,000. Capital stock, $5,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers, $600; city, none, hydrant rental being free.

Management.—Prest., Gaylord Curtis. Secy. and Supt., C. A. Miller.

TAMAQUA, *Schuylkill Co.* (Pop., 5,730; est., 7,000.) On Little Schuylkill river, in coal region 16 miles from Pottsville. Has manufactories.

History.—Built in '51 by borough.

Water Supply.—Springs, by gravity.

Reservoir.—Not described.

Distribution.—*Mains*, c. i., est., 12 miles. *Services*, w. i., lead. *Taps*, (in '84,) 1,200. *Meters*, not given. *Hydrants*, kind not given, 85. *Valves*, kind not given.

Consumption, not given. *Pressure*; Ordinary, 65 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., (in '84,) $480. Ann. rev.: (in '84,) consumers, $6,600; city, none.

Management.—Borough Council. Prest., A. H. Glassmire. Secy., Frank Lynch.

NOTE:—All requests for official data made since '85 have been ignored.

TACONY, *Philadelphia Co.* (Pop., est., 5,000.) A suburb and branch P. O. of Philadelphia, on the Delaware river. Has large saw and file works, also rope manufactory.

History.—Built in '78-9 by Disston Water Co., the works being owned and operated by Henry Disston & Sons in connection with their factory and real estate interests. Engr., Saml. Bevan, Tacony, the present Supt. Work done by the Co.

Water Supply.—Delaware river, pumping direct and to tank.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls.

Tank.—Cap., 55,000 galls.

Distribution.—*Mains*, c. i., length not given. *Services*, lead. *Taps*, *Meters* and *Hydrants*, not given.

Consumption, 800,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 130 lbs.

Financial.—Cost, not given. No debt. Ann. op. exp. and rev., not given.

Management.—Prest., Hamilton Disston. Treas., Jacob S. Disston. Supt., Saml. Bevan.

TARENTUM, *Allegheny Co.* (Pop., 1,245; est., 3,000.) On Allegheny river and Bull creek, 20 miles from Pittsburgh. Has natural gas wells and considerable trade.

History.—Built in '86 and extended in '88. In '86 H. M. Brackenridge laid pipe along a few streets and supplied about 100 families, water being taken from springs. In '88 the Tarentum Water Co. was organized, bought the existing works, and extended them. Const. Engr. and Contr. for latter, Jas. H. Harlow, Pittsburgh.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Smith & Vaile pump, dy. cap., 750,000 galls.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, c. i., 11 miles. *Services*, not given. *Taps*, 120. *Meters*, none. *Hydrants*, not determined at time of report.

Consumption, not determined. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $50,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., Ann. rev.: consumers, not given; city, not determined.

Management.—Prest., J. B. Ford. Secy. and Treas., Jno. W. Hemphill. Supt., Felix McDowell.

TIDIOUTE, *Warren Co.* (Pop., 1,255; est., 1,600.) Engaged in manufacturing.

History.—Built in '71 Tidioute Water Co.

Water Supply.—Mountain stream fed by springs, by gravity from impounding to distributing reservoir.

Reservoir.—*Impounding*: Formed by dam four miles from town, cap. not given *Distributing*: Cap., 520,000 galls.; 160 ft. above town.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 135. *Meters*, none. *Hydrants*, Mathews, 27. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 65 lbs.

Financial.—Cost, $40,000. Capital stock, $26,000. Bonded debt, $1,200. Int., 4%. Ann. op. exp., $500. Ann. rev.: consumers, withheld; city $500. Hydrant rental, $14.81.

Management.—Prest., Theo. W. Irwin. Treas., H. H. Cummings. Secy., Wm. R. Dawson. Supt., M. C. Bowen.

TIOGA, *Tioga Co.* (Pop., 520.)

History.—Built in '74 by T. A. & C. H. Wickham; in '88 the Tioga Water Works Co. was incorp. and now controls the works. Engr., C. H. Wickham.

Water Supply.—Beatty creek, by gravity from impounding to distributing reservoir. In case of serious drought pumping is used. The creek is a mountain stream fed by springs, and has a drainage area of 9 sq. m.

Reservoir.—*Impounding*: Cap., 14,000,000 galls.; formed by dam across stream in mountain. The first reservoir had a cap. of 3,000,000 galls., was formed by a timber dam, and water passed from it through a filter of sand and charcoal in a wooden crib, thence through a 6-in. conduit of banded staves to distributing reservoir. *Distributing*: Cap., about 1,000,000 galls.; is near town, 100 ft. sq. at top, 80 at bottom, and 15 ft. deep.

Pumping Machinery.—Worthington duplex, cap. not given.

Distribution.—*Mains*, Wyckoff wood, 3.2 miles. *Services*, galv. i. *Taps*, and *Meters*, not given. *Hydrants*, Ayers, 14.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 to 90 lbs.

Financial.—Cost, $20,000. Capital stock, $15,000. No debt. Ann. op. exp., in '80, $250. Ann. rev.: consumers, not given; city, $350. Hydrant rental, $25.

Management.—Prest., E. G. Schieffelin. V. Prest., H. L. Baldwin. Supt., Secy. and Treas., T. A. Wickham.

TITUSVILLE, *Crawford Co.* (Pop., 9,046; est., 9,500.) On Oil creek, on sloping ground surrounded by hills about 100 ft. high. Engaged in refining and selling oil, manufacturing boilers, artesian and oil well machinery, flour and fruit barrels, brooms and furniture. Incorp. a city in '66.

History.—Built in '73 by city. Const. Engr., M. E. Bassett.

Water Supply.—Wells, direct pumping. Two wells 15 ft. in diam. by 22 ft. deep, and one driven well 10-in. in diam. and 60 ft. deep, from which water flows to the others. The wells are in a gravel stratum.

Pumping Machinery.—Cap., 1,500,000 galls.; Holly quadruplex and rotary pumps, one Holly tubular boiler of 80 and one of 50 H. P. and one 80 H. P. boiler made in Titusville.

Distribution.—*Mains*, c. i., 11.05 miles. *Services*, w. i. *Taps*, 850. *Meters*, 25. *Hydrants*, Holly, 66. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Domestic, 25 lbs. Fire 90 lbs.

Financial.—Cost, $139,292. Debt, $112,600. Int., 4, 6 3-10, 7 and 8%. Ann. op. exp., $5,600. Ann. rev.: total, $12,000.

Management.—Supt. and Secy., G. W. Angier.

TOWANDA, *Bradford Co.* (Pop., 3,814; est., 5,000.) On Susquehanna river. Manufactures nails, boots and shoes and furniture.

History.—Built in '79 by Towanda Water-Works Co.

Water Supply.—Surface water by gravity, and river by pumping.

Pumping Machinery.—Cap. and kind of pump not given; 80 H. P. arched tubular boiler.

Distribution.—*Mains* c. i., 8 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Cost. debt, int., and ann. op. exp., not given. Ann. rev.: consumers, $6,000; city, $2,500. Hydrant rental, $50.

Management.—Prest. and Supt., J. J. Griffiths. Treas., Winthrop Pond. Secy. Frank K. Daniels.

TREMONT, *Schuylkill Co.* (Pop., 1,785; est., 2,200.) Is 13 miles from Pottsville, and engaged in coal mining and iron manufacturing.

History.—Built in '66, it is not stated by whom, and operated since '74 by Tremont Water & Gas Co. Const. Engr., Price Wetherill. All work is now done under the direction of the Supt.

Water Supply.—Small mountain stream, and springs, by gravity.

Reservoir.—Cap., 1,000,000 galls.; of stone and earth.

Distribution.—*Mains*, c. i., about 2 miles. *Services*, galv. i., lead. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading. *Taps*, 100. *Meters*, none. *Hydrants*, Mellert, 20. *Valves*, Mellert.

Consumption, 12,000 galls. *Pressure*: Ordinary, 50 lbs. Fire 60 lbs.

Financial.—Cost, $26,000. Capital stock, $10,480; authorized, $40,000. Bonded debt, $10,000. Int., 5%. Ann. op. exp., $50. Ann. rev., consumers, $820; city, $30.

Management.—Supt. and Secy., I. P. Bechtel.

TROY, *Bradford Co.* (Pop., 1,241; est., 1,500.) In agricultural and dairying district, 25 miles from Elmira, N. Y.

EDWARD WATER CO.

History.—Built in '80.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. *Taps*, 50. *Meters*, none. *Hydrants*, Ludlow, 3. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs.

Financial.—Cost, $3,500. Debt, int., ann. op. exp. and rev., not given.

Management.—R. J. Redington.

TROY WATER CO.

History.—Built in '80.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, kind not given, 2 miles. *Services*, not given. Taps, 200. *Meters*, none. *Hydrants*, Ludlow, 3. *Valves*, Ludlow.

Consumption, 100,000 galls. *Pressure*: Ordinary, 25 lbs.

Financial.—Cost, $4,000. Debt, int., ann op. exp. and rev., not given.

Management.—E. B. Parsons.

TUNKHANNOCK, *Wyoming Co.* (Pop., 1,241; est., 2,500.) On Susquehanna river at the mouth of Tunkhannock creek, in valley surrounded by hills. The elevation of the town varies about 40 ft. Settled in 1780; incorp. a borough in '44.

History.—Built by Slocum Spring Water Co. in '59, and rebuilt in '70 after plans by Harvey Sickler. The charter is perpetual. Contrs. for rebuilding, R. D. Wood & Co., Philadelphia.

Water Supply.—Slocum spring and Susquehanna river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington, and Gordon & Maxwell pumps.

Filter.—Hyatt, dy. cap., 300,000 galls.

Reservoir.—Cap., 600,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, w. i. *Taps*, 140. *Meters*, none. *Hydrants*, R. D. Wood & Co.'s, 27. *Valves*, do.

Consumption, unknown. *Pressure*: 40 to 60 lbs.

Financial.—Cost, $24,000. Hydrant rental, $15, three years' contract. All other data withheld from this issue.

Management.—Prest., F. C. Bunnell. Secy., Henry Harding. Supt. and Treas., Wm. C. Kittredge.

NOTE:—There is another company from which we have no data.

TYRONE, *Blair Co.* (Pop., 2,678; est., 4,500.) On north fork of Juniata river, on uneven ground at the foot of the Allegheny mountains. Engaged in iron, lime, leather, paper, lumber and anthracite coal trade. Settled in '50; incorp. a city in '56.

History.—Built in '70 by Tyrone Gas & Water-Works Co.

Water Supply.—Sinking Spring run, by gravity from impounding reservoir. The stream has a mountain drainage area of 15 sq. m.

Reservoir.—Cap., about 100,000 galls.; formed by dam 3 ft. high and 20 ft. long, at 114 ft. above the town, which diverts water into a 10-in. pipe leading to town. The first pipe was of wood, which after 12 years service was replaced with cast-iron.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., block i. *Taps*, 550. *Meters*, none. *Hydrants*, Morris & Tasker, R. D. Wood & Co.'s, 28. *Valves*, principally Ludlow.

Consumption, est., 350,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $100. Ann. rev: consumers, not given; city, $84. Hydrant rental: the city puts in the hydrants and pays $2 each for water.

Management.—Prest., C. Guyer. Secy., A. A. Stevens. Supt., C. H. Dieffenbaugh.

ULYSSES, *Potter Co.* (Pop., est., 600.) On hilly ground.

History.—Built in '86 by Lewisville Water Co., after plans and under the direction of the Supt., Perry Brigham.

Water Supply.—Springs, by gravity for domestic use, and pumping for fire protection.

Pumping Machinery.—Windmill, driving a 3-in. pump with 16-in. stroke.

Reservoirs.—Cap., for domestic use, 26,000, and for fire, 45,000 galls.

Distribution.—*Mains*, 3-in. c. i., 3 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Chapman, 7. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—Cost, $5,000. Capital stock, $4,000. Bonded debt, $1,000. Int., 6%. Ann. op. exp., "very light." Ann. rev.: consumers, $500; city, $120. Hydrant rental, $20.

Management.—Supt., Perry Brigham.

UNION CITY, *Erie Co.* (Pop., 2,171; est., 3,000.) In agricultural district, and is engaged in manufacturing.

History.—Built in '85 by Wm. Dunmeyer.

Water Supply.—Creek, pumping to tank.

Pumping Machinery.—Cap., not given; one Knowles and one Earle pump, and portable boiler.

Tank.—Cap., 50,000 galls.

Distribution.—*Mains*, kind not given, 0.5 miles. *Services*, w. i. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 7.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—No data given.

Management.—Supt., Wm. Dunmeyer.

UNIONTOWN, *Fayette Co.* (Pop., 3,265; est., 6,000.) In rolling country on Redstone creek. In agricultural, coke and iron region. Incorp. a borough in 1783.

History.—Built in '83 by Uniontown Water Co. Engr., C. W. Knight, Rome.

Water Supply.—Springs, by gravity from impounding reservoir.

Reservoirs.—Combined cap., 18,000,000 galls.; one of 16,000,000 and one of 2,000,000 galls. Contracts for a new 5,000,000-gall. reservoir were let in '88 to Wm. Turner & Robt. Boyd.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 500. *Meters*, not given. *Hydrants*, Mathews, 55.

Consumption, not given. *Pressure*: Ordinary, 160 lbs. Fire, 160 lbs.

Financial.—Cost, not given. Debt, $25,000. Int., 6%. Ann. op. exp. and rev., not given.

Management.—Prest., W. H. Playford. Treas., M. H. Bowman. Supt., G. H. Seaton.

WARREN, *Warren Co.* (Pop., 2,810; est., 6,000.) On Allegheny river at mouth of Conewayo creek, on hilly ground in oil region. The river here is 1,200 ft. above sea level and rises about 12 ft. at time of freshets. Settled in 1795; incorp. a borough in '32.

History.—Built in '81-2 by Warren Water Co. Engr., Geo. O. Cornelius. Contrs., R. D. Wood & Co., Philadelphia. Sub-Contrs. for masonry, Ohren & Schwartz; for buildings, James Nixon.

Water Supply.—Allegheny and Morrison's rivers, by gravity, and by pumping to reservoir.

Pumping Machinery.—Cap., not given; two duplex Knowles pumps having 16-in. steam and 20-in. water cylinders, with adjustable stroke of 14 to 20-in.

Reservoir.—Cap., 1,500,000 galls.; in excavation and embankment, 100 by 200 ft. at water line, and 15 ft. deep.

Distribution.—*Mains*, 14 to 4-in. c. i., 14 miles. *Services*, lead. *Taps*, (in '82), 150. *Meters*, one in '82. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire, 135 lbs.

Financial.—Cost, to '84, $60,000. Capital stock, $80,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., (in '83.) $800. Ann. rev.: consumers, not given; city, $1,000. Hydrant rental, $20.

Management.—Prest., O. C. Allen. Treas., Wm. Pollard. Supt. and Secy., W. B. Meredith.

WALSTON, *Jefferson Co.* (Pop., not given.) A mining town owned by Rochester & Pittsbugh Coal & Iron Co.

History.—Built by above Co. to supply their coke ovens and the town, date not given.

Water Supply.—Artesian well 300 ft. deep, pumping to tank.

Pumping Machinery, Tank, Distribution and Financial data not given.

Management.—Genl. Mgr., Jas. Haskill.

WASHINGTON, *Washington Co.* (Pop., 4,292; est., 7,000.) On Chartier's creek, in farming, sheep-raising and bituminous coal region. The town is lighted and heated by natural gas, and oil has been found near by.

History.—Built in '87-8 by Citizen's Water Co., which is controlled by Kittanning Consolidated Water Cos. of Kittanning. Charter is perpetual. Des. Engr., R. H. Wilson. Const. Engr., Jas. McCullough, Jr. Contrs., Coon & Co., Washington. Sub-Contr. for masonry and buildings, Foegey & Co., Washington.

Water Supply.—Chartier's creek, pumping from filtering wells near impounding, to distributing reservoir.

Pumping Machinery.—Deane duplex pump, dy. cap., 3,000,000 galls.

Reservoirs.—Combined cap., 16,000,000 galls.; distributing, 3,000,000, and impounding, 13,000,000 galls.

Distribution.—*Mains*, 12 to 4-in. c. i., 26 miles. *Services*, not given. *Taps* and *Meters*, not given. *Hydrants*, Holyoke, 40.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—Cost, $325,000. Capital stock, $250,000. Mortgage bonds, $75,000, Int. 6%. Ann. op. exp., not determined. Ann. rev.: consumers, not determined; city, $2,000. Hydrant rental, $50.

Management.—Prest., Samuel Hazlitt. Treas., Wm. Pollock. Secy., Geo. H. Fox, Kittanning.

WATSONTOWN, *Northumberland Co.* (Pop., 1,481; est., 3,000.) On west branch of Susquehanna river. Has manufactories.

History.—Built in '87 by Watsontown Water Co. Des. Engr., J. E. Mathews.

Water Supply.—White Deer creek, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 2,400,000 galls.; two Worthington pumps.

Reservoirs.—Four, combined cap., 2,000,000 galls.

Distribution.—*Mains*, kind not given, 7 miles. *Services*, *Taps* and *Meters*, not given. *Hydrants*, kind not given, 34.

Consumption, not given. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $40,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp. and rev. not given.

Management.—Prest., S. B. Morgan. Secy., Wm. F. Shay. Supt. and Treas. Robt. Buck.

WAYNE, *Delaware Co.* (Pop., est., 500.)

History.—Built in '81 and owned by Drexel and Child, proprietors of the Wayne estate. Engr., Isaac S. Cassin, Philadelphia. Contr. for masonry and buildings, Henry Frorer, Philadelphia.

Water Supply.—Ithan creek and Gulf Stream, pumping to reservoir.

Pumping Machinery.—Dy. cap., 284,168 galls.; a 213,168-gall. Worthington at main, and 71,000-gall. Delameter at secondary station.

Reservoir.—Cap., 250,000 galls.

Distribution.—*Mains*, 6-in. c. i., 7 miles. *Services*, lead. Pipe and specials furnished and pipe laid by I. S. Cassin. *Taps*, (in '84) 17. *Meters*, none. *Hydrants*, 40.

Consumption, 85,000 galls. *Pressure*: Ordinary, 32 lbs.

Financial.—Cost, $20,000. No debt. Ann. op. exp., in '83, $800. Ann. rev.: not given.

Management.—Mgr., Frank Smith. Engr.-in-Charge, B. F. Slaw.

WAYNESBOROUGH, *Franklin Co.* (Pop., 1,888; est., 4,000.) In agricultural region. Manufactures fruit evaporators, threshing machines and steam engines.

History.—Built in '82 4 by Waynesborough Water Co. Engr., E. P. McGinley, Danville. Contr., American Construction Co., Philadelphia.

Water Supply.—Mountain springs, by gravity.

Reservoir.—Cap., 1,500,000 galls.; 123 ft. sq. and 15 ft. deep.

Distribution.—*Mains*, 12 to 4-in. c. i., 9 miles. *Services*, galv. i. *Taps*, 500. *Meters*, none. *Hydrants*, Mathews, 26. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 85 lbs.

Financial.—Cost, $75,000. Bonded debt, $39,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $5,600; city, $390.

Management.—Prest., Caleb H. Horne. Supt. and Secy., Geo. S. Meyer. Asst. Supt., Jno. R. Hoeflich.

WAYNESBURGH, *Greene Co.* (Pop., 1,208; est., 2,500.)

History.—Built in '87-8 by Waynesburgh Water Co. Engr., Jas. H. Harlow, Pittsburgh.

Water Supply.—Ten Mile run, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,100,000 galls.; one 800,000 and one 300,000-gall. Smith & Vaile pump, and two steel tubular boilers, 12 by 48 ft.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., about 4 miles. *Services*, lead, iron. *Taps*, 25. *Meters*, not given. *Hydrants*, Holyoke, 28. *Valves*, Holyoke.

Consumption, not determined. *Pressure*: average, 125 lbs.

Financial.—Cost, about $75,000. Authorized capital stock, $50,000. Bonds, $25,000. Bonds issued, $12,000. Int., 6%. Ann. op. exp. and rev. from consumers, not determined. Hydrant rental, $50.

Management.—Prest., Wm. Pollock. Treas., J. D. Singley. Supt. and Secy., L. N. Singley.

NOTE:—Not finished at time of report.

WEATHERLY, *Carbon Co.* (Pop., 1,977; est., 3,000.) In coal mining district, and has railroad repair shops.

History.—Built in '81-2 by Weatherly Water Co., after plans of the directors, and under supervision of the Prest. Contr., H. L. Foster, Pottsville.

Water Supply.—Penrose creek, and springs, by gravity.

Reservoir.—Cap., 250,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 325. *Meters*, none, *Hydrants*, Bailey, said to be 150. *Valves*, B. E. Lehman.

Consumption, 25,000 galls. *Pressure*: Ordinary, 90 lbs.

Financial.—Cost, $25,000. Capital stock, $12,000. Debt, $3,000. Int., 5%. Ann. op. exp., not given. Ann. rev.: consumers, $2,000; city, not given.

Management.—Prest., W. W. Blakeslee. Treas., A. J. Landerburn. Secy., S. G. Eby. Acting Supt., B. F. Clewell.

WELLSBOROUGH, *Tioga Co.* (Pop., 2,228; est., 3,000.) In mining and agricultural section.

History.—Built in '86 by Wellsborough Water Co. Engr., H. C. Heermans, Corning, N. Y.

Water Supply.—Springs, by gravity to and from reservoir.

Reservoir.—Cap., about 70,000,000 galls.; is 700 by 800 ft. and its greatest depth is 20 ft.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i. *Taps*, (in '86,) 49. *Meters*, (in '86,) 10. *Hydrants*, Mathews, 41. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 86 lbs. Fire, 86 lbs.

Financial.—Cost, $95,000. Capital stock, $75,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, not given; city, $2,050. Hydrant rental, $50.

Management.—Supt., W. C. Kress. Other officers: W. Bache, J. Harrison.

WEST BETHLEHEM, *Southampton Co.* (Pop., est., 3,000.) All data included under So. Bethlehem, which see.

WEST CHESTER, *Chester Co.* (Pop., 7,046; est., 11,000.) On an elevated ridge between Chester and Brandywine creeks, and about two miles from each. Is 16 miles from Wilmington, Del., and 21 from Philadelphia. Settled in 1780; incorp. a borough in 1789.

History.—Built in '45-6 by borough. Engr. and Contr., Isaac S. Cassin, Philadelphia. Sub-Contr. for masonry, Ely Baldwin, West Chester; for buildings, Levi Shingles, West Chester.

Water Supply.—Chester creek, which is fed by springs, pumping to reservoir. The first supply was from Bath springs, pumped through 4,800 ft. of 8 and 6-in. c. i. pipe to reservoir. In '54 the source was changed to Chester creek, 2 miles from town. There was a settling basin 125 ft. sq. at pumping station, used only when stream was muddy.

Pumping Machinery.—Dy. cap., 500,000 galls.: Worthington duplex pump.

Force Mains. In '54 a 6-in. force main was laid, 10,560 ft. long, to connect the new supply to the reservoir. In '81 an additional force main, 12 in. in diam., was laid to connect with a new reservoir.

Reservoir.—Cap., 2,500 000 galls.; is 150 by 175 ft. and 14 ft. deep, 91 ft. above pump and from 35 to 100 ft. above town.

Distribution.—*Mains*, c. i., 13 miles. *Services*, c. i. *Taps*, 1,500. *Meters*, 3. *Hydrants*, Cassin, 250. *Valves*, Csssin.

Consumption, 500,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 70 lbs.

Financial.—Cost, $55,000. Debt, including other borough debts, $100,000. Int., 4%. Ann. op. exp., (in '85,) $4,986. Ann. rev: total, $15,000.

Management.—Chief Burgess, Marshall S. Tray. Supt., Chas. F. Henry.

WEST PITTSTON, *Luzerne Co.* (Pop., 2,544.) All data included under Pittston, which see.

WICONISCO, *Dauphin Co.* (Pop., est., 1,800.)

History.—Supplied since '86 by Lykens Water Co. All data included under Lykens, which see.

WILKES BARRE, *Luzerne Co.* (Pop., 33,339: est., 40,000.) On east side of North branch of Susquehanna river, in center of Wyoming valley anthracite coal fields. Has axle works, silk lace mills, and other manufactories. Settled in 1770: incorp. a borough in '06, a city in '71.

CRYSTAL SPRING WATER CO.

Supplies part of the city and also Ashley, but *will give no information.* T. H. Phillips is connected with the Co.

WILKES BARRE WATER CO.

History.—Built in '57-9. Engr., Dr. Chas. F. Ingram, Wilkes Barre. The Co. did all work except laying pipe, which was done by Patent Gas & Water Pipe Co., Jersey City, N. J.

Water Supply.—Laurel run, by gravity, and by pumping to reservoir. The first supply was by gravity from an impounding reservoir on the stream at a point 2½ miles from the city and 150 ft. above its general level. A larger reservoir has been built since and a pump added.

Reservoir.—Combined cap., 48,000,000 galls.: 8,000,000 and 40,000,000 galls., respectively, the largest, being the last one built.

Dam.—For first reservoir. Of stone, 8 ft. thick at bottom, 5 at top, and 20 ft. high: built on a curve with convex side up stream.

Pumping Machinery.—Worthington compound condensing, dy. cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 48 miles. *Services*, w. i. *Taps*, 4,400. *Meters*, none *Hydrants*, Ayers, Mathews, 101. *Valves*. Eddy, Ludlow.

Consumption, 3,250,000 galls. *Pressure*: Ordinary, 37½ lbs. Fire, 45 lbs.

Financial.—Cost, (to '81), $220,000. Capital stock (in '81.) $22,000. No debt. Receipts for year ending Apr., '81, were $29,415. Present rev. from city for fire hydrants, $1,262.50, or $12.50 each. Other financial data for '88 withheld.

Management.—Prest., B. G. Carpenter. Secy. and Treas., B. M. Espy. Supt., Roger McGarry. Report for '88 made by Frank Deitrick, City Clerk.

WILLIAMSPORT, *Lycoming Co.* (Pop.,18,934; est., 28,000.) On West branch of Susquehanna river, at the foot of a range of hills. Lycoming creek flows through the city. Has steam saw mills, furniture factories, iron foundries and machine shops. Founded about 1795; incorp. a city in '61.

History.—Owned and operated by the Williamsport Water Co., and Citizen's Water & Gas Co. (Combined.) The first Co. was incorp. in '53, when the population was about 2,500, and built its works in '56-9. In '65 the Lycoming Gas & Water Co., now Citizen's Gas & Water Co., was incorp. Both Co.'s are now under one management, and the charters are perpetual.

Water Supply.—Two mountain streams, by gravity. Supplemented in the fall by pumping direct, surplus passing to reservoir. The first Co. took its supply from Hagerman's run and the second from Mosquito creek. Both streams are south of the river, and each drains about 25 sq. m.

Reservoirs.—One 729 by 650 ft. with water 17 ft. deep at breast of dam, and one 70 by 100 ft., by 10 ft. deep throughout.

Pumping Machinery.—One 4,000,000-gall. Knowles compound condensing pump with 80 H. P. steel tubular boiler, and a smaller Knowles pump, for emergency, with 60 H. P. boiler.

Distribution.—*Mains*, c. i., 53 miles. *Services*, galv. i. with brass corporation cocks. *Taps*, 3 600. *Meters*, 1. *Hydrants*, 249; these are put in and owned by city, but Mathews are recommended after trial of several kinds. *Valves*, Eddy, Ludlow, Galvin, Chapman, now using latter exclusively.

Consumption, over 2,000,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 75 lbs. at pump.

Financial.—Cost, $500,000. Debt, $225,000. Int., 5%. Ann. op. exp., not given. Ann. rev.: consumers, (in '86,) $37,610; city, $1,788. Hydrant rental, city owning hydrants, $10.

Management.—The officers of the two Cos. are the same, except the Prests.: Williamsport Water Co., Jas. M. Gamble. Citizens Water & Gas Co., Jno. White. Treas., J. V. Brown. Secy., W. H. Bloom. Supt., J. H. McMinn.

YORK, *York Co.* (Pop., 13,940; est., 20,500.) On both sides of Codorous creek, in thickly populated agricultural district. Manufactures iron and steel, railway cars and agricultural implements. Settled in 1720.

History.—Built in '16, by York Water Co.

Water Supply.—Springs and surface water, pumping to reservoirs.

Pumping Machinery.—Dy, cap., 1,100,000 galls. The first pump was a Birkinbine, and a Worthington was added later. A Deane pump is now reported as in use. It is thought that there are two boilers in use here which were designed by Frederick Graff for the Fairmount pumping station, Philadelphia.

Reservoirs.—Combined cap., 11,000,000 galls.; 90 ft. above pumps and 15 ft. above highest part of town. Built by the Co.

Distribution.—*Mains*, c. i., 22 miles. *Services*, lead. Pipe used recently has been bought of S. Bechtal & Co., York, and laid by Co. *Meters*, Crown, 2. *Hydrants*, Ludlow, Birkinbine, 76. *Valves*, kind, do.

Consumption, 600,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 25 lbs.

Financial.—Cost, $200,000. The capital stock of the Co. was first $10,500 and is now $190,000. No debt. Ann. op. exp., withheld. Ann. rev.: consumers, $36,000; city, none, hydrant rental being free.

Water-Works Projected with Fair Prospects of Construction.

BRIDGEPORT, *Montgomery Co.* (Pop., 1,802; est., 3,000.)

Proposed System.—To pump water from Schuylkill river to reservoir at a cost of about $70,000. Works to be owned by Bridgeport Water Co. Engrs., Powell & Middletown, 327 New St, Philadelphia. Address Jno. Bartholomew, Bridgeport, for further data.

Present Supply.—Wells.

DUBOIS, *Clearfield Co.* (Pop., est., 7,000.) Engaged in mining coal and handling lumber.

Proposed System.—The borough will rent fire plugs, and contracts from 500 consumers can be obtained if a company or individual will build works.

Present Supply.—About ½ mile of pipe, a few hydrants, or cisterns, and a force pump. City Clerk, W. C. Pentz.

IRWIN, *Westmoreland Co.* (Pop., 1,444; est., 2,500.) Is 21 miles from Pittsburgh, and engaged in coal mining.

Proposed System.—The Irwin Water Co., controlled by the Westmoreland Water Co., of Greensburgh, will take a supply from Greensburgh by gravity next season. The pipe lines in town and a reservoir just outside will cost about $35,000. The contract has been let to Pennsylvania Pipe Mfg. Co., Germantown, Pa. F. Z. Shellenberg is Prest., and Murray Forbes of Derry Station, Secy. of the Co.

Present Supply.—None, except five cisterns filled from roofs of buildings. Town Clerk, S. C. Remsberg.

MONTROSE, *Susquehanna Co.* (Pop., 1,722; est., 2,000.) In an agricultural district.

Proposed System.—The Montrose Water Co. was organized in '87 and proposed to complete works in '88. Water to be pumped from a lake, two miles from the court house, to a reservoir, the system to cost about $20,000. C. G. Darrach, Philadelphia, Engr.; B. K. Jamison, Prest., and J. H. Kershow, Secy., both at Third and Chestnut Streets, Philadelphia.

Present Supply.—Wells, and 12 cisterns supplied from buildings. Town Clerk, W. S. Cox.

ROCHESTER, *Beaver Co.* (Pop., 2,552; est., 5,000.) At junction of Beaver with Ohio river. Manufactures carriages, coffins and glassware.

Proposed System.—The Rochester Water Co., Jno. M. Buchanan, Prest., will build works in '89, pumping from the Ohio river through a filter gallery to a 5,000,000-gall. reservoir. There will be a 3,000,000-gall. pump, 7 miles of 4 to 10-in. mains, 60 hydrants, an ordinary pressure of 135, and fire pressure of 185 lbs. The works will cost about $100,000. The franchise runs for 30 years with $2,750 yearly for 60 hydrants.

Contracts have been let to Ellis Morrison, Newcastle, who is also Engr. It is expected that work will be begun May 1, '89. Jno. M. Buchanan is Prest. and A. W. McCoy, one of the directors of the Co.

Present Supply.—Wells and cisterns.

SCOTTDALE, *Westmoreland Co.* (Pop., 1,275; est., 3,000.)

Proposed System.—Address Harry Taylor, Secy.

Water-Works Projects Reported in '87-8, but Now Indefinite.

Kuztown, *Berks Co.*; Littlestown, *Adams Co.*; Schwenksville, *Montgomery Co.*

MARYLAND.

Water-Works Completed or in Process of Construction.

ANNAPOLIS, *Ann Arundel Co.* (Pop., 6,642; est., 8,000.) On Severn river two miles from Chesapeake bay and 20 from Baltimore, in fruit-growing country. Engaged in oyster trade and has glass factory. Settled in 1620; incorp. a city about 1720.

History.—Built in '65-6 by Annapolis Water Co. Engr., Wm. R. Hutton.

Water Supply.—Springs and surface water, pumping to reservoir. Water from several springs and small streams is collected in one stream, a dam forming a reservoir.

Reservoirs.—Combined cap., 8,250,000 galls; 6,000,000 and 2,250,000 galls., respectively. The distributing reservoir has puddled clay banks paved with granite.

Filter.—Beneath the distributing reservoir, consisting of a brick-lined trench covered with wooden slats ½ in. apart, upon which is a layer of coarse gravel, then fine gravel, then 1 ft. of sand. A 10-in. main connects with the trench, and conveys the filtered water 4 miles to town. The main was originally of wrought iron and cement, which frequently broke, and was replaced with cast-iron in '79.

Pumping Machinery.—Dy. cap., not given. The first pump placed in '66, had a 10-in. cylinders and a dy. cap., of 500,000 galls. A second pump was placed in '81 with 12-in. water cylinders.

Distribution.—*Mains*, c. i., 9.5 miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, 6. *Hydrants*, kind not given, 45.

Consumption, not given. *Pressure*: 38 lbs.

Financial.—Cost, $65,000. Capital stock, $61,450. Bonded debt, $15,000. Int., 6%. Ann. op. exp., (in '84,) $5,000. Ann. rev.: (in '84,) consumers, $12,000; c'ty, $290.

Management.—Prest. and Supt., Wm. H. Gorman. Secy. and Treas., D. C. Handy.

BALTIMORE, *City of Baltimore Co.* (Pop., 332,313; est., 400,000.) At head of navigation and tide water on Patapsco river, 14 miles from Chesapeake bay, and 200 miles from the ocean. Has an area of about 16 sq. m. Topography is irregular, the city being divided by a stream called Jones' falls, east of which the ground rises from 13 to 262 ft., and on the west, from 4 to 233 ft. above tide level. There are 762 acres at elevations ranging from 171 to 233 ft. Engaged in foreign and domestic commerce, and manufacturing; has large oyster, tobacco, fruit and vegetable trade. Founded in 1730.

History.—First supplied in May, '07, by private company. In '54 the city bought the works and from '57-62 enlarged them. In '80 the Gunpowder river supply was introduced.

In '04 when the population was about 30,000, an association was formed for the purpose of "introducing a copious supply of wholesome water into the city of Baltimore." The water privileges of Jones' falls, immediately above and below the present Eager street bridge, were bought, and plans prepared by Jno. Davis of Philadelphia, Pa.

In June, '05 a contract was made for cast-iron pipe from 2¼ to 6 in. in diam., and in Feb., '06, the Common Council authorized the company to lay pipe in the streets. In May, '07, pumps located at the corner of Centre and Calvert streets supplied the city by pumping to reservoirs at various heights above tide-level. In '08 the Legislature granted the company a suitable charter and in '11 its income was $9,000.

In '33 Salisbury Mill was bought, and a new reservoir and pump-house built. There were then 2,164 takers, and a yearly income of $21,300. In '35 about 18 miles of pipe had been laid, one fourth of old, one-half of new pattern cast-iron, and the rest of wood. Some of the old iron pipe was dug up in '64. It was 3 in. in diam., in sections 5 ft. long, very heavy, with conical joints. It was in perfect condition, the sand outside having united with the iron by oxidation, thus preventing further corrosion. The inside of the pipe was worn smooth, and had a slight coating of earthy matter.

From '35 to '52 additional privileges were bought on Jones' falls, new pumps and reservoirs added, and the distribution system extended. In '52 the Company's revenue was $80,000.

In '54 the city bought the works, privileges and real estate of the company for

$1,350,000. There were at the time two small pools on Jones' falls from which water was conducted by gravity through iron mains to a receiving reservoir on the bank of the stream below Charles St. bridge, and distributed from here to that part of the city not more than 60 ft. above mean tide.

The district not exceeding 136 ft. above mean tide was supplied from a reservoir at Charles and Chase Streets, to which water was pumped. The combined capacity of the reservoirs and the pools on the stream was 35,000,000 galls., and the water was frequently quite turbid. When the city bought the works 69 miles of pipe had been laid.

In '57-62 the city built new works on Jones' falls. Des. and Consulting Engr., Jas. Slade. Chf. Engr., Chas. P. Manning. In '72 a plan for an additional supply was submitted by R. K. Martin, the present Chf. Engr., approved by Chas. P. Manning, then Consulting Engr., and finally adopted. Pending the construction of permanent works for the additional supply from Gunpowder river, a temporary supply was obtained from the same source.

The Jones' Falls System, Temporary Gunpowder Supply, and the Gunpowder River System are described separately below. All data under the head of Distribution, Financial and Management is common to both systems, and is given in its usual place.

JONES' FALL SYSTEM.

General Description.—A dam across Jones' Falls forms a reservoir called Lake Roland, from which a conduit conveys water to Hampden reservoir, which supplies the districts between 112 and 188 ft. above tide-level. Pipe lines lead from Hampden to Mt. Royal reservoir, which supplies the lowest part of the city. A reservoir called Druid lake, built for additional storage, now lies between Lake Roland and Hampden reservoir, and water is pumped from this to a high service reservoir in Druid Hill park.

Impounding Dam.—Forms Roland lake, and is of rubble masonry, faced with cut stone. It is 40 ft. high, has an overflow 120 ft. long, at 225 ft. above tide, flanked by wing walls 6 ft. higher. The dam is built across a narrow gorge, is founded on rock, backed with earth, and has a vertical back and curved face.

Roland Lake.—Has a water area of 116 acres, and all the surface flooded was first excavated to a depth of at least 10 ft. below the overfall.

In freshets the water carries much dirt, which is deposited in the lake. In '72 a large amount of sediment was removed, and again by dredging in '76-7.

Conduit.—Extends from Lake Roland to Hampden reservoir. Brick, elliptical, the bottom being a semi-circle 5 ft. in diam., and the top a semi-ellipse 3.83 ft. high, giving an inside area of 24.75 sq. ft. for 3.62 miles. On embankments the conduit rests on a wall of rubble masonry.

Hampden Reservoir.—In form of semi-circle, 1,000 ft. in diam., with area of 8 acres, at 217 ft. above tide. In excavation and embankment, the inner slopes covered with 3 ft. of puddle, on which is 2 ft. of gravel, and over that an 18-in. stone pavement. This reservoir supplies the part of the city between 112 and 188 ft. above tide-level. It was built in connection with the new works from '57-62.

Three lines of 30-*in. cast-iron pipe* are laid from this to Mt. Royal reservoir, 7,100 ft., passing under Jones' falls in a trench cut from 3 to 5 ft. in rock.

Mount Royal Reservoir.—Circular, 550 ft. in diam., having a water surface of 5 acres, at 150 ft. above tide. The screen well is in the center of the reservoir, and one of the mains from Hampden reservoir extends through its roof, where its contents may be discharged as a fountain under 60 ft. head. This reservoir supplies that part of the city less than 112 ft. above tide-level.

Druid Lake.—Cap., 463,000,000 galls. Built from '64-71 to increase the storage capacity of the existing reservoirs, and to give a large supply of clear water for use when the stream becomes muddy. The reservoir was formed by building a dam, described below, across a natural valley in Druid Hill park. A part of the natural bottom was irregular, and an area about 300 by 900 ft. was filled with from 3 to 25 ft. of dirt, flooded as it was thrown in.

The embankments are faced with a riprap of large stones, arranged with some care, extending from 2 ft. above to 10 ft. below high water level. The upper 6 ft. of the slope is covered with clean gravel from 1 to 3 in. in diam. The greatest depth of water is at the dam, 65 ft.; some other parts have a depth of 63 ft., and the upper end, 20 ft.

Druid Lake Dam.—Earth embankment, 119 ft. high in middle, with puddle heart-wall 36 ft. thick at bottom. The latter is carried down 12 ft. below the natural surface, where it is founded on rock with a core of rubble masonry in cement, 5 ft. high and 2 to 4 ft. wide. Adjoining the puddle wall the embankments were built up in layers, carted on, rolled and rammed for about 25 ft. in height. The remainder of the bank was made by building two lines of trestles, one half way between the center and the foot of each slope, and dumping dirt from these. This left a space in the center, which was flooded with water and then gradually filled with dirt.

Inlet and Outlet Pipes.—Beneath the dam there were first laid seven lines of cast-iron pipe. These were carried on masonry piers through the puddle wall, and simply enclosed in the embankment the rest of the way. Within two years they all broke, and those with less than 44 ft. of earth above them were removed. The others were capped and left in place.

Later, five lines of 30-in. pipe were laid through the dam, in a cut in the rock, on 9 in. of rubble masonry placed on 9 in. of concrete, and enclosed in rubble masonry. The whole wall was 25 ft. wide at the bottom, 23 ft. at top, and 5.5 ft. high with collars of masonry carried around the pipes into the rock and earth cuts. There is also a wall on each side of the top of the masonry, from collar to collar, 1 by 1½ ft. The sides and top are plastered, making smooth surfaces. Clay puddle covers the whole for 5 ft.

Three of these pipes are used for distributing water to the city. One connects with the low service main from Hampden reservoir, discharges 900 ft. up the lake, and can be used to drain the lake. The fifth pipe connects with the high service main from Hampden reservoir, discharges 2,300 ft. up the lake, and can be used as a siphon to empty the lower 24 ft. of the lake. In '72 an additional inlet pipe was laid.

Pumping Machinery.—Cap., 6,000,000 galls.; Worthington pump, located at Druid lake, and used to fill the Druid Park high service reservoir.

Druid Park High Service Reservoir.—Is 501 ft. in diam., 20 ft. deep, 600 ft. from Druid lake, and 350 ft. above the tide. It is in earthwork, puddled 4 ft. on inner slopes, then covered with 1 ft. of gravel. When filled the north embankment leaked, and after the pumps stopped the water fell 12 ft., but with alternate raising and lowering the leakage through the banks was greatly lessened.

Water was first admitted to the reservoir, June 8,'74. From the force main leading to this reservoir a branch extends to Druid lake, and then turns upwards, making a fountain which may be supplied from the high service reservoir or by direct pumping. The daily capacity of this high service supply is 6,000,000 galls., and it furnishes water to that part of the city from 188 to 320 ft. above the tide.

GUNPOWDER TEMPORARY SUPPLY.

Introduced in '74 for use while building the permanent works. Water was pumped from Great Gunpowder falls over a ridge 205 ft. high into the headwaters of Lake Roland, the impounding reservoir on Jones' falls. There were two, 5,000,000 gall. Worthington pumps forcing water through a 36 in. main.

GUNPOWDER SYSTEM.

General Description.—Plans adopted in '72 and works completed in '80. This system was designed to give an additional independent supply. A dam on Gunpowder river, about 9 miles from the city, forms a reservoir five miles long called Loch Raven. From this a tunnel nearly 7 miles long leads to a large reservoir called Lake Montebello, from which a conduit extends a mile to a distributing reservoir known as Lake Clifton. The total cost of this system to Dec. 31, '80, was $4,704,261.

Gunpowder River Dam.—Of stone masonry, founded on rock, 65 ft. wide at bottom, 34 ft. at the overfall and 8 ft. higher at the wings. The overfall is 300 ft. long, and the wings extend some distance further. The top of the overfall is 170 ft. above tide-level. The foundations of the dam were carried 13 ft. below the water surface of the stream, and were built in three sections by means of coffer dams.

Loch Raven Reservoir.—Formed by above dam, and is 5 miles long and 20 ft. deep at the dam. The borders of the stream have been excavated to the original stream-level, the material being placed in embankments outside the flow line.

Tunnel.—From Loch Raven to Lake Montebello. Is circular, 12 ft. in diam., 36,500 ft. long, with a fall of 1 ft. a mile. It was begun Dec., '75, and finished Nov., '80. It is straight throughout its length, is from 65 to 300 ft. below the surface, and for 6 miles extends through hard blue gneiss rock, for one mile through limestone, in which large quantities of water, many fissures, and several pockets of semi-fluid material were found. Fifteen shafts were sunk, and the headings worked at 32 points. Only 11,691 ft. of the tunnel were arched. All drilling was done by hand, and blasting by giant powder or dynamite. The cost of excavating the tunnel was $1,382,599, and for arching, cleaning and filling the shafts $397,011, making the total cost, $1,779,610.

Lake Montebello.—Cap., about 500,000,000 galls. Is irregular in shape, having a water surface of 80 acres at 163 ft. above tide, and is formed by two embankments across a ravine. A stream ran through the ravine, but its water being impure, it was diverted around the reservoir by an 8-ft. tunnel.

A conduit conveys water from Lake Montebello to Lake Clifton, the distributing reservoir. This is partly in tunnel and partly in open cut, and is 5,391 ft. long.

Lake Clifton.—Used as a distributing reservoir; elliptical, 1,700 ft. by 1,200 ft., having an area of 30.25 acres, a depth of 31 ft. and an elevation of 163 ft. above tide. Provision is made for six 40-in. distributing mains from this reservoir. But two of these mains were first put in use.

CAPACITY OF THE TWO SYSTEMS.

The average daily flow of the Jones' falls stream in '87 was 33,416,000 galls., and of the Gunpowder river, 234,333,333 galls. For 10 days in '87 Jones' falls was too muddy for use, and for 108 days the same was true of Gunpowder river. The Jones' falls system sent to the city an average of 14,387,750 galls. a day, and the Gunpowder river, 19,343,333, making a total daily average from both systems of nearly 34,000,000 galls. Of this there was pumped to the high service reservoir from the Jones' falls system a daily average of about 2,800,000 galls.

Distribution.—*Mains*, c. i., 358 miles. *Services*, 1½ in. c. i. *Taps*, 66,089. *Meters*, 784. *Indicators*, 238. *Hydrants*, made by department, 1,062. *Valves*, kind, do.

Consumption, about 34,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $10,886,979. Debt, $9,500,000. Int., 4, 5 and 6%. Ann. op. exp., $106,694. Ann. rev.: consumers, $741,679; city, $50,421.

Management.—Seven Commrs., including the Mayor, ex-officio. Secy. of Commrs., Jno. F. Hunter. Chf. Engr., Robt. K. Martin. Engr. and Supt., County Division, Wm. L. Kinley. Water Registrar, E. Shriver.

References.—Further data regarding the Baltimore Water-Works is given in *Engineering News*, in the volumes and pages indicated—IV, 128, 245; VII., 445; VIII., 428.

NOTE:—Work was begun in the fall of '88 on a new reservoir at Guilford. The cap. will be about 40,000,000 galls. Contrs., Jones & Thorn.

CATONSVILLE, *Baltimore Co.* (Pop., 1,712; est., 3,000.)

History.—Built in '87 by Catonsville Water Co. Engr., Robt. K. Martin, Baltimore.

Water Supply.—Artesian well, and stream, pumping to tank.

Pumping Machinery.—Dy. cap., 500,000 galls,; one deep well Deane, and one Worthington pump, and two 50 H. P. boilers.

Tank.—Cap., 185,000 galls.

Distribution.—*Mains*, c. i., 8 miles. *Services*, c. i. *Taps*, 60. *Meters*, 8. *Hydrants*, none.

Consumption, 100,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 150 lbs.

Financial.—Cost, $65,000. Capital stock, $60,000. No debt. Ann. op. exp., and rev., not determined at time of report.

Management.—Prest. and Supt., I. M. Cone. Treas., V. E. Gardner. Secy., M. I. Cone.

CHESTERTOWN, *Kent Co.* (Pop., 2,350; est., 3,000.) On level ground on Chester river, 14 miles from Chesapeake bay, and at the head of navigation. Has large canning and straw-board factories. Settled over 100 years ago; Washington College located here in 1782.

History.—Built in '85 by Chestertown Water Co. Des. Engr., W. W. Taylor.

Water Supply.—Springs, pumping from collecting to distributing reservoir.

Reservoirs.—Two collecting of 30,000 and 50,000 galls. cap., respectively, and a

1,000,000-gall. distributing reservoir, the latter being in excavation, 75 ft. above the town.

Pumping Machinery.—Dy. cap., 240,000 galls.; Deane compound duplex pump, and 50 H. P. steel tubular boiler.

Distribution.—*Mains*, w. i., 4 miles. *Services*, galv. i. *Taps*, 100. *Meters*, 1. *Hydrants*, Clarks & Registin, 29.

Consumption, 30,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 50 lbs.

Financial.—Cost, $25,000. Debt, $15,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,250; city, $550. Hydrant rental, $20.

Management.—Prest., C. T. Westcott. Secy., M. W. Thomas. Chf. Engr., Wm. T. Sutton.

CUMBERLAND, *Allegheny Co.* (Pop., 10,693; est., 13,000.) On Potomac river, on rolling ground, in center of bituminous coal region of the State. Has glass, iron and steel manufactories, and is engaged in trade and shipping. The Baltimore & Ohio R. R. shops and buildings are supplied from works of their own.

History.—Built in '70-1 by city, and enlarged in '73. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Potomac river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly-Gaskill pump. The first pump, and that added in '73, was replaced by a new one in '80.

Distribution.—*Mains*, 3 to 12-in. c. i., about 30 miles. *Services*, ½ to 1-in., kind not given. Pipe and specials furnished by Gaylord, of Covington, Ky., and pipe laid under direction of Supt. Wilson. *Taps*, about 1,800. *Meters*, none. *Hydrants*, Holly, 200. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 85 to 90 lbs. Fire, 110 to 130 lbs.

Financial.—Cost, $150,000. The original cost was $99,864. Bonded debt, $150,000. Int., 5%. Ann. op. exp., $7,000. Ann. rev.: consumers, $10,000.

Management.—Comm. of City Council. Supt., Asa Wilson. Report made by Jas. A. Millholland.

EASTON, *Talbot Co.* (Pop., 3,005; est., 4,500.) Has some manufactories and considerable trade.

History.—Built in '86 by Easton Water Co. of Talbot Co. Engr., Isaac S. Cassin, Philadelphia, Pa. Contr. for masonry, Chas. E. Tippett, Harrisburg; for buildings, Edw. Roberts, Easton.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 35,000 galls.; Holly-Gaskill pump, and Harrisburg boiler.

Stand-Pipe.—Is 12 ft. in diam. and 100 ft. high. Contr., Chas. E. Tippett, Harrisburg.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. w. i. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J. Pipe laid by Crook, Horner & Co., Baltimore. *Taps*, 225. *Meters*, 1. *Hydrants*, Cassin, 40. *Valves*, Cassin.

Consumption, 35,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $38,000. Capital stock, $40,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, not given; city, $1,000. Hydrant rental, $25.

Management.—Prest., Dr. I. L. Adkins. Treas., R. B. Dixon. Supt. and Secy., Wm. E. Shanahan.

FREDERICK, *Frederick Co.* (Pop., 8,659.) On level ground surrounded by hills. A small stream called Carroll run flows through the center of the city. Has manufactories. Settled over 100 years ago; incorp. a city in '05.

History.—Present works built by city prior to '80, date not given, and enlarged in '80. The first supply was introduced by a private company, from Sawmill branch of Carroll run, and from springs on Mt. Philip farm. These works were abandoned some years ago and works built by city, but neither this date, or that of building the first works, is given.

Water Supply.—Springs, artesian wells, and mountain stream called Great Tuscarora, by gravity. Water from nine springs in the Catoctin mountains, and two artesian wells, is brought by covered drains to a "receiving house," and conveyed thence by 4½ miles of 6-in. cast-iron pipe to a distributing reservoir. In '80 the supply was increased by bringing water to the reservoir from the Great Tuscarora, through 6¼ miles of 8-in. cast-iron pipe having a fall of 273 ft.

Reservoir.—Cap., 1,900,000 galls.; in excavation and embankment, 125 ft. sq., 17 ft. deep, and lined with brick. It is a mile northwest of the city and 75 ft. above it. Two lines of 10-in. pipe conduct water from the reservoir to the city.

Distribution.—*Mains*, c. i. No other data given.

Financial.—The bonded debt in '82 was $70,000 at 5% int.

Management.—Address the Mayor, or C. N. Hahn.

NOTE:—No returns from these works since '82.

FROSTBURGH, *Allegheny Co.* (Pop., 4,057; est., 5,000.) On plateau between Savage and Dan's mountains, 1,792 ft. above the sea, 17 miles from Cumberland, and in bituminous coal region. Settled and incorp. a borough in '50.

History.—Built in '54 by Frostburgh Water Co., with Nelson Beall, now deceased, as Engr. In '64 improvements were made at the source of supply with T. L. Patterson, Cumberland, as Engr.

Water Supply.—Springs and four artesian wells, by gravity from collecting reservoir, with tank for fire protection. The springs are on Savage mountain, one mile from town.

Reservoir.—Is 60 ft. sq. by 12 ft. deep, lined with stone. Enlarged in '88 to about four times its original capacity by excavating on three sides. The addition will not be lined with masonry. In '63 the 4-in. cast-iron main from the reservoir had become so filled with rust that it was replaced by a 6 in. main of the same material.

Tank.—Wooden, on mountain, cap. not given.

Distribution.—*Mains*, 8 to 4-in. c. i., 4 miles. *Services*, galv. i. Pipe and specials furnished by H. J. McShane, Baltimore, R. D. Wood & Co., Philadelphia, Pa., Atwood & McCaffery, Pittsburgh, Pa. Trenching done by Co. with day laborers, and pipe laying by B. F. Schofield, Frostburgh, now deceased. *Taps*, about 260. *Meters*, none. *Hydrants*, various kinds, mostly cheap, 27. *Valves*, Eddy.

Consumption, 30,000 galls. *Pressure*: from 90 to 110 lbs.

Financial.—Cost, $22,000. Capital stock, issued, $10,000; authorized, $20,000.- Bonded debt, $4,600. Int., 6%. Ann. op. exp., $350. Ann. rev.: consumers, $1,700; city, $150 for 27 hydrants, or $5.55 each.

Management.—Prest. and Secy., W. O. Sprigg. Supt., D. I. Williams.

HAGERSTOWN, *Washington Co.* (Pop., 66.27; est., 10,000.) In rolling limestone country, between North and South mountains of the Blue Ridge range, ¾ miles from Antietam creek. Laid out in 1762 by Capt. Jonathan Hager; incorp. in '14.

History.—Built in '81-2 by Washington County Water Co. Des. Engr., Robt. K. Martin. Const. Engr., Geo. W. Harris, Hagerstown. Work was done by the Co.

Water Supply.—Beaver creek, at its head waters on South mountain, 8 miles from town, and artesian wells, by gravity.

Settling Basin.—Is ¾ miles from the confluence of several springs forming the creek, has a cap. of 1,500,000 galls. An old mill pond was used for this purpose.

Reservoir.—Cap., 20,000,000 galls. Formed by an earth dam, is 213 ft. above center of town. This and the settling basin cost $14,000.

Conduit.—To town; 7¾ miles of 12-in. cast-iron pipe laid 3 ft. deep, following the surface grade, which is very irregular. There are 8 gates on the line.

Distribution.—*Mains*, c. i., 18 miles. *Services*, galv. i. *Taps*, 640. *Meters*, 17. *Hydrants*, Mathews, 56. *Valves*, Ives, Kennedy.

Consumption, 500,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.?

Financial.—Cost, $140,000. Capital stock, $80,000. Bonded debt, $40,000. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: consumers, $8,000; city, $1,000 for hydrants, or $17.86 each.

Management.—Prest., W. F. Hamilton. Secy., Edw. Stake. Supt. and Treas., C. F. Manning.

HAVRE DE GRACE, *Harford Co.* (Pop., 2,816; est., 3,500.) On Susquehanna river, near head of Chesapeake bay. Engaged in coal and lumber trade, fruit canning, and shad and herring fishing. Settled before Revolutionary war.; incorp a town in '74.

History.—Built in '83-4 by Havre de Grace Water Co. Engr., W. W. Taylor, Philadelphia.

Water Supply.—Susquehanna river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 360,000 galls.; Davidson pump, and Babcock & Wilcox boiler. A duplex Blake pump of 6-in. bore and 12-in. stroke was in use in '84.

Reservoir.—Cap., 4,000,000 galls.; covers 1¼ acres, is 250 ft. above pump, and 210 ft. above town.

Distribution.—*Mains*, 4 and 6-in. lap-welded w. i., 3½ miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Clark's, 37.

Consumption, not given. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $20,000. Debt, $15,000. Int., 6%. Ann. op. exp., $390. Ann. rev.: consumers, $700; city, $500. Hydrant rental is paid by the town at the rate of five cents on each $100 of taxable property within city limits.

Management.—Prest., A. P. McCombs. Secy., Chas. Zeitler. Treas., R. K. Vanneman. Supt. and Engr., J. W. Maslin.

MECHANICSTOWN, *Frederick Co.* (Pop., 730; est., 1,000.) Near Monocacy river, 16 miles from Frederick. Engaged in iron and copper mining.

History.—Built in '87 by Mechanicstown Water Co. of Frederick Co. Work done by Co. without Contr.

Water Supply.—Mountain stream, by gravity.

Reservoir.—Cap., 50,000 galls.

Distribution.—*Mains*, 6-in. c. i., 2½ miles. *Services*, not given. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading, Pa. *Taps*, 75. *Meters*, none. *Hydrants*, Mellert, 18.

Consumption, not determined. *Pressure*, Ordinary, 80 lbs.

Financial.—Cost, $9,700. Capital stock, $10,000. No debt. Ann. op. exp., not given. Ann. rev.: consumers, $400; city, $216. Hydrant rental, $12.

Management.—Prest., Van B. Osler. V. Prest., J. R. Rouzer. Treas., Geo. W. Stocksdale. Supt. and Secy., S. M. Birely.

SALISBURY, *Wicomico Co.* (Pop., 2,581; est., 3,500.) On Wicomico river. Engaged in lumber trade, fruit raising and market gardening.

History.—Built in '88 by Salisbury Water Co., after plans and under superintendence of L. S. Bell, without Contrs. for labor.

Water Supply.—Twelve 6-in. wells for domestic use, and Wicomico river for fire protection, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 650,000 galls. Hughes duplex compound pump.

Stand-Pipe.—Is 12 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, 8, 6, 4 and 3-in. c. i., 4½ miles. *Services*, galv. i., lead. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading, Pa. *Taps*, 75. *Meters*, not given. *Hydrants*, Mellert, 2. *Valves*, Chapman, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $25,000. Debt, $12,500. Int., 4%. Ann. op. exp. and rev., not determined at time of report. Hydrant rental, $25.

Management.—Prest., S. P. Dennis. Secy., Treas. and Supt., L. S. Bell.

UNION BRIDGE, *Carrol Co.* (Pop., 579; est., 1,100.) Has shops and grain elevators of Western Md. R. R.

History.—Built in '86-7 by Union Bridge Water Co. Engr., Edw. D. Crook. Contrs., Crook, Horner & Co., Baltimore.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 250,000 galls.; Worthington compound pump.

Reservoir.—Cap., 425,000 galls. An unofficial report states that a new reservoir was built in '88, of about the same size as the old one.

Distribution.—*Mains*, 4 and 6-in. c. i., 2½ miles. *Services*, ¾-in. galv. i. *Taps*, about 100. *Meters*, not given. *Hydrants*, Mathews, 18. *Valves*, Peet.

Consumption, 40,000 galls. *Pressure*: 40 to 60 lbs.

Financial.—Cost, $17,000. Capital stock, $12,000. Bonded debt, $5,000. Ann. op. exp., $300. Ann. rev.: consumers, $500; city, $350.

Management.—Prest., M. C. McKinstry. Secy., Jno. S. Repp. Supt., J. M. Hollenberger.

WESTMINSTER, *Carrol Co.* (Pop., 2,507; est., 3,000.) On rolling ground a the headwaters of the Patapsco river, 29 miles from Baltimore. Has manufactories. Settled in 1775; incorp. a town in '58.

History.—Built in '83 by Westminster Water Co. Engr., W. W. Taylor, Philadelphia. Contr. for masonry, C. Await; for buildings, Geo. Leare.

Water Supply.—Three springs, pumping to reservoir. The springs are one mile from town, and water is conducted from them through earthenware pipes to a pool holding 500,000 galls., from which it passes through screens to pump-well.

Pumping Machinery.—Worthington pump, dy. cap., 118,000 galls.

Reservoir.—Cap., 1,000,000 galls.; is 150 ft. in diam., 12 ft. deep, in earth embankment, riprapped and puddled, and is 145 ft. above the pump, and 180 ft. above the lowest point in town.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. Pipe and specials furnished by Ives & Co., Baltimore. Trenching and pipe laying done by Geo. Harris, Hagerstown. *Taps*, 275. *Meters*, 7. *Hydrants*, kind not given, 40.

Consumption, 10,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $25,000. Total capital stock, $25,000, of which $5,000 is preferred. Debt $25,000, of which $20,000 is in bonds. Int., 6% Ann. op. exp., $1 000. Ann. rev.: consumers, $1,800; city, $900. Hydrant rental is paid by town on the basis of five cents on each $100 of taxable property in the city limits.

Management.—Prest., Wm. A. McKillip. Secy., A. H. Huber. Treas., Wm. B. Thomas. Supt., Chas. H. Baughman.

Water-Works Projected with Fair Prospects of Construction.

CENTREVILLE, *Queen Anne's Co.* (Pop., 1,196; est., 1,800.) On Corsica river.

Proposed System.—The village voted in '88 to build works, the supply to be pumped from artesian well to stand-pipe. Est, cost, $15,000. Address W. F. Harman.

ELLICOTT CITY, *Howard Co.* (Pop., 1,471; est., 2,000.) In narrow gorge on both sides of Patapsco river. Has good water-power.

Proposed System.—Nothing definite has been decided upon. Address M. G. Sykes. City Registrar, Jas. E. Nausant.

TOWSON, *Baltimore Co.* (Pop., 1,316.) Is 7 miles north of Baltimore.

Proposed System.—The Towsontown Water-Works Co. was organized in '87. Borings for water have been made but with little success as late as Mar., '88. Since then an unofficial report states that plenty of water has been found, and that works will be built. No late official information can be obtained. Officers: Prest., Jackson Piper. Secy., S. C. Tomay. Engr., Chas B. McClean.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Cambridge, *Dorchester Co.*; Elkton, *Cecil Co.*; Guilford, *Howard Co.*; Woodberry, *Baltimore Co.*

DISTRICT OF COLUMBIA.

Water-Works Completed.

WASHINGTON and GEORGETOWN. (Pop.: Washington, 147,293; Georgetown, 12,578. Total, 159,871.) Washington is on the Potomac river at the head of tide-water, 184 miles from the ocean. It has a water front of about 4 miles on the Potomac river, and 3¾ miles on the eastern branch. Most of the city is flat with slight elevation, but the Capitol is 89.5 ft., and some points 104 ft., above mean tide. Georgetown is west of Washington, separated from it by Rock creek. Some points in its surface are 200 ft. above tide. Washington was incorp. in '02 with a population of 4,000.

History.—Built in '53-9 by U. S. Government. Engr., Capt. M. C. Meigs, Corps of Engrs., U. S. A. In '63 Potomac water was introduced, the dam at Great Falls having been built after plans of Silas Seymour. July 15, '82, Congress approved an act "to increase the water supply of the City of Washington" by extending the Great Falls dam, building a large reservoir, connecting the old and proposed new reservoir by a tunnel, and laying proper distributing mains from the new reservoir to the city.

Contracts for the work were let in the fall of '83. The dam was finished in Aug., '86, the reservoir nearly or quite so in '87, and the tunnel in '88. The new work has been under the direction of the U. S. Engineers. The part of system outside the city and for supplying the Government buildings, is under the control of the U. S., and the distribution system is managed by the municipal authorities.

Water Supply.—Potomac river, by gravity, with pumping to reservoir and direct for high service supply. A large dam across the river 17 miles from the city forms an impounding reservoir, from which an aqueduct conveys water 9 miles to a receiving reservoir, and thence two miles to a distributing reservoir. The new aqueduct tunnel conveys water nearly 4 miles to the new distributing reservoir.

From Jan., '59 to Dec., '63, the supply was from the present receiving reservoir, which is formed by a dam across Powder Mill branch, a stream having a drainage area of over 4,000 acres. In '64-5 a conduit was built from the inlet to the outlet of the distributing reservoir, so the water from the Powder Mill stream need not be used when muddy. A similar method was carried out at the distributing reservoir, which makes possible direct distribution from the aqueduct.

Dam.—Across Potomac river at Great Falls. Begun in '63 or '64, and in '67 was finished as it stood until extended in connection with the new works. It was built of cut stone masonry, backed with riprap, was 1,034 ft. long, with its top 146¾ ft. above tide level at the Washington Navy Yard. This reached across the two northern channels of the river to Conn's island. The late extensions cross the island with a masonry dam about 4 ft. high, and the other channel to the Virginia shore with a maximum height of 20 ft. The length of the new part is 1,843 ft., making the present total length of the dam 2,877 ft. The old dam was raised by a coping to the height of the new part, 148 ft. Contrs. for new dam, Chittenden Bros. the price being $94,293.75.

Aqueduct.—From the river a culvert was built under the Chespeake & Ohio R.R to a gate-house. Here water passes into the aqueduct, which is 9 ft. in diam., has a grade of 0.791 ft. to the mile, and has its invert at the dam 151 ft. above tide-level. The material used was either rubble masonry or brick laid in hydraulic cement the material used being governed entirely by the cost at any given locality. The thickness of the brick ring was 1 ft. The greater part of the aqueduct is in cut, the bottom section of which is carefully dressed to a semi-circular form and the ring laid upon the earth. All embankments were carefully built to a level with the center of the conduit, left a season for settling, then excavated for the lower half of the conduit, the ring here also being laid on the earth. Before water was let in cracks appeared in the conduit, but although some parts of the aqueduct have settled a foot no serious breaks have occurred. Nine miles from the dam the conduit enters the receiving reservoir and is continued two miles to the distributing reservoir. In '64-5 a connection was made between the inlet and outlet of the first reservoir, and later the same thing was done at the second, making a direct connection between the river and the city.

Griffith Park and Cabin John Bridges.—The aqueduct crosses the valleys of two streams on masonry bridges. The Griffith Park bridge is an elliptical arch of 75 ft. span and 15 ft. rise. Cabin John bridge is a segmental arch of 220 ft. span at an elevation of 101 ft. above water in the creek, the rise of the arch being 57.25 ft. This is the longest, but one, single span masonry bridge in the world. The voussoirs of the bridges are of dressed Quincy granite with a superimposed arch of squared sandstone. The brick conduit is carried over the bridges, the backing being of rubble masonry, and the sidewalls of the bridges of squared sandstone. When water was first admitted the aqueduct leaked badly on Cabin John bridge. The leak was stopped by cleaning the conduit at this point and hacking the lower half of its inside with hatchets until rough, then plastering it with two coats of Rosendale cement mortar, well rubbed on. The second coat was applied before the first was dry, and the two were ½ in. thick.

Receiving Reservoir.—Cap., 176,000,000 galls. above the bottom of the outlet. Is 9 miles from the dam on the Potomac, has an area of about 50 acres, and was formed by damming Powder Mill branch. No description of this dam is given. The distance between the conduit inlet and outlet is 3,600 ft., which has been connected as already stated.

Distributing Reservoir.—Cap., 150,850,000 galls. Two miles from receiving reservoir, in excavation and embankment, in two divisions, nearly rectangular with, water surface of 43 acres at the flow line, which is 146 ft. above the tide. Inner slopes are lined with dry walls, 12 to 18 in. thick laid on 6 in of broken stone. The conduit connecting the influent with the effluent gate-houses is on the north side, 7 ft. in diam.

Supply Mains.—Originally three lines led to the city from this reservoir, of 12, 30 and 36-in. pipe.

College Pond and Rock Creek Bridges.—College pond is crossed by two 30-in. flanged cast-iron pipes, arched, the span being 120 ft. Rock creek, between Washington and Georgetown, is crossed by a bridge of 200 ft. span and 20 ft. rise, composed of two ribs of 48-in. cast-iron pipes, 1½ in. thick, flanged and bolted together, supporting iron trusses on which a roadway is carried. From '62-76 a horse car track was carried on this bridge. Since '76 the passage of heavily loaded wagons and carriages has been forbidden. The pipes of the arch were at first lined with wooden stones to prevent freezing, but the lining was soon removed.

GEORGETOWN HIGH SERVICE.

Pumping Machinery.—The pump lately at the Washington high service station has been placed here, and is probably the 2,000,000-gall. Worthington pump erected at the former station in '79. From '60 to '75 a Worthington water-power pump was used. It was placed in one of the abutments of the Rock creek bridge, and driven with water from the supply main.

Reservoir.—Brick, hemispherical, 120 ft. in diam. and 220 ft. above tide. This reservoir leaked considerably, owing to a defective arrangement of the influent and effluent pipes. It supplies that part of Georgetown more than 90 ft. above tide-level.

WASHINGTON HIGH SERVICE.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two Holly-Gaskill pumps and boilers placed here in '87 or '88. About nine-tenths of the pumping here is direct the remainder being to a stand-pipe erected in '79.

NEW TUNNEL AND RESERVOIR, BUILT '84-8.

New Aqueduct Tunnel.—Connecting old and new distributing reservoirs. Is 20,715.8 ft. long, and has a cross-section 11 ft. wide by 7½ ft. high, giving an area of 82.5 sq. ft., without lining. When it is lined the section is reduced to 76.34 sq. ft. Sunk from five shafts, and except for a short distance at the upper end it is through hard, solid rock. The shafts to tunnel grade have depths of 97, 69, 58½, 137½ and 162 ft., the first being at the inlet, and the last at the outlet. Most of the excavation for the shafts was done by hand, but for that in the tunnel Ingersoll "Eclipse" rock drills were used. These were worked by compressed air carried to the drills by 12 to 4-in. pipes, about 10 miles of pipe being required for the work. (See references, below.) Contrs. for tunnel, Beckwith & Quackenbush, the contract price, exclusive of lining, which could not be estimated, was $548,100. Owing to delayed appropriations and alleged frauds the tunnel will cost over $1,000,000. Ii ts stated that some of the lining may have to be replaced by better work.

Reservoir.—Cap. about 300,000,000 galls. Is star-shaped with area of 67 acres, and 30 ft. of water above flow line. Contrs., Maloney & Gleason, Price, $298,980.

Connections with city distribution.—From the effluent gate of new reservoir a 75-in. cast-iron pipe extends 661.6 ft. and terminates in three 48-in. branches, only one of which was intended for immediate use. From here a 48-in. pipe leads to the old 36-in. main. Connection between these two was made by a special three-way casting, water being cut off but 45 hours and 50 minutes for the operation. The 75-in. pipe was furnished by the West Point Foundry Association, West Point, N. Y., and the 48, 12, 8 and 6-in., with special castings, by A. H. McNeal, Burlington, N.J.

Distribution.—*Mains*, c. i., 128 miles. *Services*, galv. i. *Service connections*, 27,639, there being 22,095 taps. *Meters*, very few. *Fire hydrants*, kind not given, 1,013; 936 in Washington and 77 in Georgetown. *Street hydrants*, 278; these supply on the average 30 families each, and there is no revenue from them. *Stop-Valves*, 1,373.

Consumption, 26,147,952 galls. This amount is an average for the seven years from '81 to '87, inclusive, of measurements made for each hour in one of the last days of June. Assuming the population supplied as 200,000, the consumption per capita per day is 130 galls. The hour of maximum consumption for the seven years is between 9 and 10 a. m., when it has been 1,265,639 galls., or at the rate of 30,375,336 galls. for 24 hours, or 150 galls. per day per capita. The hour of minimum consumption has been from 2 to 3 a. m., 897,709 galls., or 100 galls. per day per capita. If the consumption for the 24 hours was at the same rate as the minimum it would be over 21,500,000 galls. This indicates an enormous waste, as little water can actually be used from 2 to 3 a. m.

Pressure: From 18 to 24 lbs.

Financial.—Cost, about $8,500,000. Debt, (in '85,) $875,000. Int., 3%. Ann. op. exp., $13,980; there was expended in the same year $27,891 for contingent expenses outside the fiscal year, and $59,891 for new mains and hydrants, and labor in placing them. These figures are from the report for the year ending June 30, '87.

Management.—Engineer Commissioner of the District of Columbia, Col. Wm. Ludlow, Corps of Engrs., U. S. A. Asst. to above, Capt. Thos. W. Symons, Corps. of Engrs., U. S. A. Supt., H. F. Hayden. Chf. Clerk, Jno. J. Beall.

References.—To *Engineering News*:

Describing the new tunnel, and the compressed air plant used for drilling, with illustrations, vol. XI., p. 75; also regarding the tunnel, vol. XI., p. 23, XV., 253, XVI., 159. Leaks and breaks in mains, vol. XVII., pp. 33, 247, 418, and break in 36-in. main, XX., 21. The reservoir in connection with the new tunnel, vol. XI., p. 4 Suit for injunction against extending dams across Virginia channel of Potomac, (defeated), vol. XIV., p. 123. Description of new dam, tunnel and reservoir, vol. XIII., 105. In papers on Municipal Engineering, Washington, vol. XVI., pp. 182-3. and pp. 196-7. The latter gives department specifications for cast-iron water-pipe, details of bell and spigot joint, and descriptions and illustrations of the distribution system.

GROUP 3.—South Atlantic States.—Water-Works Completed in Process of Construction or Projected, in Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.

VIRGINIA.

Water-Works Completed or in Process of Construction.

ALEXANDRIA, *Alexandria, Co.* (Pop., 13,659; est., 16,000.) On south bank of Potomac river, 6 miles below Washington, D. C. The ground rises from the river to an elevation of 50 ft. Engaged in coal trade, foreign and domestic commerce and manufacturing. Has good harbor. Founded about 1780. In Dec., '52, the works had cost $88,000, there were 180 takers, and the next year, 400 takers.

History.—Built in '58 by private company, when population was about 9,000. Des. Engr., Frederick Erdman.

Water Supply.—Cameron's run, pumping to reservoir.

Dam.—Power for pumping was first furnished by a mill-dam, which was swept away by a freshet in '67, but a small dam above gave necessary power, until washed away during the war. The third dam was seriously damaged during a storm in '67.

Pumping Machinery.—When the works were built a 20-ft. water wheel drove a double-acting pump of 10-in. bore and 120-in. stroke. In '55 a steam pump was added. No data regarding the present pumps has been given.

Reservoir.—The first was 200 ft. sq., 16 ft. deep, 96 ft. above the tide, and in two divisions. A 10-in. main led to the city. During the war a slide occurred in its bank, and in '67 a storm damaged it. In '74 a new reservoir was built after plans by Washington Blythe. It is in excavation and embankment, 300 by 500 ft., by 17.5 ft. deep. In '79 slight leaks were reported.

Distribution.—(in '81.) *Mains*, c. i., 15.9 miles. *Services*, not given. *Taps*, 573. *Meters*, not given. *Hydrants*, kind not given, 147.

Consumption, (in '81.) 803,468 galls. *Pressure*: not given.

Financial.—Original cost, $88,000. From '51, to Jan. '59, the total expenditures were $125,399, and the receipts, $46,162. In '79 the expenses were $4,241, and the receipts, $14,631. No other financial data given.

Management.—Prest. B. Wheat. Secy. and Treas., T. E. Fendall. Supt., Francis Power. These were the officers the latter part of '87.

NOTE:—All inquiries addressed to the Co. since '81 have been ignored.

CHARLOTTESVILLE, *Albemarle Co.* (Pop., 2,676: est., 6,000.) In an agricultural and fruit growing district, and is engaged in manufacturing.

History.—Built in '86 by town. The reservoir was built jointly by the town and the University of Virginia, the latter paying about $250,000. The works of the University are described in their order. Des. Engr., E. W. Bowditch, Boston. Coutrs., McConnell & Hickler, Buffalo.

Water Supply.—Surface water and springs, by gravity from reservoir.

Reservoir.—Cap., 192,000,000 galls.; is about 5 miles distant.

Distribution.—*Mains*, iron, 11 miles. *Services*, w. i. Pipe and specials furnished by Newark Foundry Co. *Taps*, 268. *Meters*, none. *Hydrants*, Chapman, 50. *Valves* Chapman.

Consumption, not given. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $107,500. Bonded debt, $85,000. Int., 6%. Ann op. exp., $1,500. Ann. rev.: not given.

Management.—Comm. of three. Chairman, W. O. Fry. Supt., G. J. Harris.

CHATHAM, *Pittsylvania Co.* (Pop., 543.) In tobacco growing and mineral region.

History.—Built by town. No further data can be obtained in time for insertion here. Address Wm. J. Overby.

CREWE, *Nalloway Co.* (Pop., not given.)

A new town on the Norfolk & Western R. R.

History.—The Norfolk & Western R. R. Co. let the contract for works to Glamorgan Co., Lynchburg, work to begin June 15, and be finished Aug. 15, '88.

Water Supply.—Creek, pumping to tank.

Distribution.—No hydrants. No other data given.

Financial.—Est. cost, $12,000.

Management.—Norfolk & Western R. R. Co., offices, Roanoke, Va. No further data given.

DANVILLE, *Pittsylvania Co.* (Pop., 7,526; est., 13,000.) On Dan river in agricultural and tobacco raising district. Has two flour and several cotton mills.

History.—Built in '75, and purchased in '76 by city for $140,000, including gas-works. Engr., C. A. Ballou.

Water Supply.—Dan river, pumping to reservoir and direct.

Pumping Machinery.—Worthington pump, dy. cap., of old, 1,500,000 galls.

Reservoirs.—Cap., 6,500,000 galls.: old, 5,000,000, and new, 1,500,000 galls. The latter was built in '88.

Distribution.—*Mains*, 3 to 16-in. c. i., length not given. *Services*, lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, and labor done by city. *Taps*, 725. *Meters*, none. *Hydrants*, Ludlow, 87. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Ordinay, 65 lbs.

Financial.—Cost, for gas and water-works, about $320,000. Debt, do., $320,000: $140,000 at 8% int., and the rest at 5 and 6%. Ann. op. exp., $8,300. Ann. rev: total, about $13,000.

Management.—Comm. of three. Supt., C. A. Ballou.

FORTRESS MONROE, *Elizabeth City Co.* (Pop., 400.)

History.—Built in '84-5 by U. S. Government. Contrs., Sullivan & Conroy, Providence, R. I.

Water Supply.—"1½ Points," pumping to tank.

Pumping Machinery.—Dy. cap., about 200,000 galls.; Deane duplex pump, and compound tubular boiler.

Tank.—Is 28 by 22 by 15½ ft.

Distribution.—*Mains*, 6-in. w. i., 1½ miles. *Services*, do. *Taps*, 114. *Meters*, not given. *Hydrants*, Kennedy, Pratt & Cody, 29. *Valves*, kind, do.

Consumption, 20,000 galls. *Pressure*: Fire, 25 lbs.

Financial.—Cost, $40,000. No debt. Ann. op. exp., $1,114. No rev.

Management.—Capt. C. A. Booth, Second M. Dept., U. S. A. Engr., Richard Bond.

FREDERICKSBURGH, *Spottsylvania Co.* (Pop., 5,010; est., do.) On Rappahannock river, at head of navigation, on plain slightly above the river, and is surrounded by hills. Has manufactories and is a trade center. Settled in 1727; incorp. a village in 1727; a borough in 1781, a city in '70.

COMPANY'S SYSTEM.

General Description.—Built in '32 after plans by Alex. Henderson, taking supply from Poplar springs, 1½ miles from town. *Distribution* in '82 was through 4 miles of cast-iron mains and lead service pipes. There were then 225 taps, and no fire hydrants. No data given for '88. The works had cost $25,000, and the capital stock was $17,000. Prest., A. M. Wallace. Supt., J. M. Sener.

CITY'S SYSTEM.

History.—Built in '84-5.

Water Supply.—Rappahannock river, pumping to reservoir.

Pumping Machinery.—Blake pump, dy. cap., 400,000 galls.

Reservoir.—Cap., 4,000,000 galls.

Distribution—*Mains*, c. i., 9½ miles. *Services*, galv. i., lead. *Taps*, 675. *Meters* none. *Hydrants*, Eaves & Bro., 51.

Consumption, 225,000 galls. *Pressure*; Ordinary, 56 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $3,200. Ann. rev.: consumers, $4,000; city, none.

Management.—Supt., S. J. Quinn.

HARRISONBURGH, *Rockingham Co.* (Pop., 2,831; est., 3,200.) In agricultural region, and is a trade center.

History.—Being built in '88. Contrs., R. D. Wood & Co., Philadelphia. No other data given.

LEESBURGH, *Loudoun Co.* (Pop., 1,726; est., 2,000.) Is 38 miles west of Washington and 2 miles from the Potomac river.

History.—Built in '45 by village.

Water Supply.—Rock spring, by gravity. The spring forms a pool 18 by 8 ft., by 4 ft. deep, and is enclosed by a brick building covered with shingles.

Distribution.—*Mains*, iron, about 4 miles. The pipes extend along all streets, and water is generally taken from street hydrants and pumps, being "free to all." When desired connections are made with houses and manufactories "at an almost nominal rate." Fire protection is provided by cisterns with a cap. of from 6,000 to 10,000 galls., on all streets.

Financial.—Original cost in '45, $18,000. Ann. op. exp., about $200. Ann. rev.: not given, but small.

Management.—Water Board of three. Mayor, Jos. L. Morris. Recorder, H. O. Claggett.

LEXINGTON, *Rockbridge Co.* (Pop., 2,771; est., 3,500.) On fork of James river in a fertile limestone valley.

History.—Owned by town. The date of building original works is not given, but new work finished in '85, with Jno. McCormick as Engr., and —— Davin, of Lexington, as Contr.

Water Supply.—Springs, by gravity to and from reservoir. In '88 an additional supply was obtained by laying about 3¼ miles of pipe between Connor's spring and the reservoir. Contrs. for pipe, Glamorgan Pipe Foundry, Lynchburg.

Reservoir.—Cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., about 6 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Bailey, 11. *Valves*, Eddy.

Consumption, 75,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, about $45,000. Debt, about $45,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: not given.

Management.—Supt., Jos. B. Holmes.

LIBERTY, *Bedford Co.* (Pop., 2,191; est., 3,500.) Manufactures woolen goods, flour and tobacco.

History.—Built in '85 by town.

Water Supply.—Mountain spring, by gravity.

Distribution.—*Mains*, c. i., 9 miles. *Services*, lead. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 29.

Consumption, 45,000 galls. *Pressure*: 80 to 140 lbs.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $300. Ann. rev.: consumers, $3,000.

Management.—Supt., W. F. Fitzpatrick.

LYNCHBURGH, *Campbell Co.* (Pop., 15,959; est., 25,000.) On James river on a steep hillside rising from the river and breaking into numerous hills. A railroad center and in the Virginia iron belt. Has tobacco manufactories, iron furnaces and flouring mills. Laid out in 1786.

History.—Partially supplied in 1799; a general supply introduced in '11; works built by city in '28 and reconstructed in '79.

In 1799 "The Lynchburgh Fire Co." obtained leave from the village trustees "to sink wells and erect pumps on Main street for the convenience and safety of the citizens." Little was done by this Co. and in '11 the council granted to Jno. Lynch the privilege of conveying water in wooden pipes through the streets from the springs at the head of Hosford branch.

The town had reserved the right to use water for fire protection, and in '13 built a reservoir 12 ft. sq. near the market-house and set four fire-plugs. Water was brought about 4,000 ft., under 40 ft. head, from springs to reservoir, and distributed for about 2,500 ft. on Main street. The pipes were 10-in. logs, 10 ft. long, with 3-in. bore, jointed like modern pump-logs, and banded at the joints with iron. A log house built over the reservoir was removed in '30. In '17 Jno. Lynch sold his rights to Jas. Wade. In '28 all but two lengths of the wooden pipes were taken up, and these were found while making sewer excavations in '69. They were well preserved, and were secured by city Engineer Forsberg, but were stolen by negroes for fuel.

In '28, the population being about 5,000, water-works were built by the town. Engr., Albert Stein.

In '68, '79, '81, '82 and '88 pumps were added, and in '77-9 the works were reconstructed with A. Forsberg as Engr. Other historical details are given below.

Water Supply.—James river, pumping to low and high-service reservoirs.

The supply introduced in '28 was taken from the James river, by water power from an impounding reservoir.

In '35 the James River & Kanawha Canal Co. contracted to keep the water-works dams, canals, and races perpetually in repair, and to supply not more than 600,000 galls. a day for consumption and enough water for power to raise that amount to the reservoirs.

In '70 a freshet so injured the canal that the city's water supply was cut off and the Canal Co. could not repair its works without a $35,000 loan from the city, for which they assigned to the city all leases for water drawn from the canal. In '77 another freshet caused damage which was repaired by a second loan from the city, this time of $15,000, secured by second mortgage bonds on the canal property. The Richmond & Allegheny R.R. Co. succeeded the Canal Co. and scaled down these bonds to $3,305.83, making payment to the city. Aug. 5, '81, the latter Co. guaranteed the city one-fifth the entire flow of the James river at this point, the minimum flow being estimated at 1,000 cu. ft. a second, or 646,272,000 ft. a day, which gives the city an estimated available daily supply of about 129,000,000 galls. for consumption and use in pumping.

Dam.—Across James river to form impounding reservoir and give water-power for pumping. A dam was built at the lower end of Daniel's island, and a series of dams above connecting Jones & Woodroof's island with the opposite shore. It is not stated whether this dam has been rebuilt since '28.

Pumping Machinery.—Dy. cap., 3,000,000, or from 5,000,000 to 6,000,000 galls, with new Holly-Gaskill pump contracted for in '88.

In '28 a breast-wheel 19 ft. in diam. and 9½ ft. wide, and a 10-in. pump with 48-in. stroke were erected, and forced water through a 7-in. cast-iron pipe. In '68 a 60-in. Reynolds turbine, and a 12-in. pump of 60-in. stroke, were put in. This pump was designed by A. Forsberg.

In '79 R. D. Wood & Co. began the construction of two vertical plunger and bucket pumps, which are operated by a Jonval turbine, and so arranged that during freshets power can be supplied from a horizontal steam engine of 20 in. cylinder and 30-in, stroke, driven by two 50 H. P. tubular boilers. This pump has a dy. cap. of 1,500,000 galls., lifting 330 ft. through 4,400 ft. of pipe to the high-service reservoir.

In June, '81, the old breast-wheel and pump, constructed in '28, were removed to give room for a forebay to the new works, and a Knowles steam pump of 18-in. steam and 12-in. water cylinder, both of 18-in. stroke, was erected, pumping about 700,000 a day through the 7-in. main to the low service reservoir.

In the latter part of '81 the piston pump constructed in '68 was repaired and supplied with a new turbine, and the purchase of a 2,000,000-gall. duplex double plunger pump was authorized. The plunger pattern was adopted because the water is gritty.

In '28 a contract was made for a 2,000,000 or 3,000,000-gall. Holly-Gaskill pump.

Low Service Reservoir.—Cap., 4,000,000 galls. In two equal compartments, ½ mile from and 255 ft. above the river. This is an enlargement of the old reservoir, built in '28, which originally had a cap. of 500,000 galls., a depth of 10 ft., was in excavation and embankment, with its bottom paved with brick in cement and its sides with cobble stones. The bottom of the old reservoir leaked for many years. The drain pipe was placed 1 ft. above the bottom, increasing the labor of cleaning out the sediment which was deposited at the rate of 4 in. a year.

High Service Reservoir.—Cap., 4,000,000 galls. Built in '77-8 with money bequeathed the city by Saml. Miller in '69 on condition that it should be spent within ten years towards "furnishing a supply of water to persons residing on the hill west of the city not now [then] supplied with the James river water." The reservoir is 4,400 ft. from, and 330 ft. above the river, 232 ft. in diam. at the top, 16 ft. deep, has inner slopes of 2 to 1 lined with two courses of stone flagging in cement. The excavation was first through 1 ft. of red clay, then 10 ft. of dark tenacious clay, in which were many sandstone boulders, then porous gravel.

The first pipes were unprotected from corrosion, and the very soft river water caused them to fill rapidly with rust. A 3-in. pipe was found in Main street in '58 with its diam. reduced nearly one-half, and so weakened by corrosion that a tap could not be made without strengthening the pipe by iron bands. A section of 4-in. pipe, in use for 48 years, and badly corroded, was contributed by A. Forsberg for exhibition by the American Society of Civil Engineers at the Centennial, in '76.

The original pipes were manufactured in Philadelphia, were very hard, in 9 ft. lengths with 4 in. hubs. The 3-in. pipe was 9-16, and the 4-in. 5-8 in. thick. They were evidently cast horizontally, and some were ⅜ in. scant on one side and fully ¾ in. thick on the other. Since '68 all pipes have been coated with Dr. Angus Smith's preparation, and corrosion entirely prevented.

Distribution.—*Mains*, c. i., 16 miles. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,300. *Meters*, 3. *Hydrants*, Bailey, 160. *Valves*, Eddy.

Consumption, 1,250,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—The cost of the works built in '28 was $50,000. To '81 the total cost of construction had been $171,102, and of maintenance, repairs and salaries, $51,378. Cost to '88, not given. Debt, $350,000. Int., 5, 6 and 8%. Ann. op. exp., $8,000. Ann. rev.: consumers, $19,000; city, $5,000.

Management.—Water Comm. Chairman, James I. Lee. Registrar and Clerk, Thos. W. Greene. Supt., I. P. Page. Pumping Engr., Jno. Boze.

MANCHESTER, *Chesterfield Co.* (Pop., 5,729; est., 8,000.) On James river opposite Richmond, on ground rising gradually from the river to a range of hills 110 ft. above tide. Has extensive manufacturing interests. Settled in 1769; incorp. a town in 1769, a city, in '74.

OLD WORKS.

History.—Built in '40 by town. Des. Engr., Jas. L. Davis. These works will probably be abandoned when new works are finished.

Water Supply.—James river, pumping to reservoir, and direct in case of fire.

Dam and Canal.—Dam was of stone, 7 ft. thick and 6 ft. high, built into the river to divert water to a canal 50 by 2,000 ft., and 6 ft. deep, having a fall of 15 ft, which furnished water-power to drive pump.

Pumping Machinery.—Dy. cap., about 100,000 galls. Double-acting plunger pump of 8 in. cylinder and 36 in. stroke, made by Robt. Baird, driven by a turbine wheel under 15-ft. head.

Reservoir.—Cap., 400,000 galls.; 107 ft. sq., 5 ft. deep, and 110 ft. above pump. Bottom and inner slopes were lined with brick in cement. The bottom has leaked, giving much trouble, and in '83 a large break occurred, and a bed of quicksand was found underlying the clay bottom of the reservoir.

Distribution.—*Mains*, c. i., 0.7 miles. *Services*, lead. *Taps*, 81. *Meters*, none. *Hydrants*, "old fashioned," 7. *Pressure gauge*, Edson.

Consumption, 80,000 galls. *Pressure*; 40 lbs.

Financial.—Cost, unknown. Debt, not given. Ann. op. exp., about $200. Ann. rev.: consumers, $750; city, none.

Management.—Under control of Chief of Police.

NEW WORKS.

History.—Begun in May, '88, and to be finished within 15 months, by Wm. H. White & Bro., 32 Wall street, New York City. Provision is made for future purchase of works by city.

Water Supply.—James river, above Canoe run, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls., kind not given.

Stand Pipe.—Not described.

Distribution.—*Mains*, c. i., 5 miles, exclusive of main from pump to stand-pipe and thence to town. *Hydrants*, 50.

Financial.—Charges to consumers not to exceed those in Richmond, and Co. to be exempt from city taxation for 10 years.

Management.—Address Wm. H. White & Bro., 32 Pine street, New York City, or City Engr., F. P. Leavenworth.

MARION, *Smyth Co.* (Pop., 919; est., 1,500.) On Holston river. Engaged in mining and manufacturing.

History.—Built in '88 by the town. Contrs., Glamorgan Co., Lynchburg.

Water Supply.—Springs in freestone rock, by gravity to stand-pipe.

Stand-Pipe.—Not described.

Distribution.—*Mains*, 3 miles. *Hydrants*, 15.

Financial.—Cost, about $12,000. Bonded debt, 12,000. Int., 6%.
Management.—Recorder, J. H. Francis.
Other data not determined at time of report.

NATIONAL SOLDIER'S HOME, *Hampton, Elizabeth City Co.* (Pop., 2,900.)

History.—Built in '73 by U. S. Government. Des. Engr., J. B. H. Goff. Work was done by the Home.

Water Supply.—Wells for fresh water and Chesapeake bay for salt water pumping to tanks.

Pumping Machinery.—Dy. cap., 226,400; four small Worthington pumps, and return tubular boilers.

Tanks.—Cap., 45,000 galls.; 9 of 5,000 galls. each.

Distribution.—*Mains*, c. i., 2 miles. *Services*, c. i. *Taps*, *Meters* and *Hydrants*, not given.

Consumption, 75,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 120 lbs.

Financial.—No data given.

Management.—Governor of Home, Col. P. T. Woodfin.

NORFOLK, *Norfolk Co.* (Pop., 21,966; est., 30,000.) On Elizabeth river, on an arm of Chesapeake bay, 31 miles from the ocean, on low flat ground. Has good harbor and is engaged in foreign and domestic commerce and manufacturing. Founded in 1705; incorp. a borough in 1736; a city in '45. Engr., Robert K. Manning.

Water Supply.—First Moore's Bridges, Lakes Lawson and Bradford, by direct pumping. In '87-8 there were pumped from First Moore's Bridges a total of 100,857,655 galls., from Lake Lawson, 496,689,267 galls., and from Lake Bradford 272,106,492 galls., making a total of 869,653,414 galls.

Two small dams at Moore's Bridges were built to form reservoirs of 40,000,000 galls. cap. In '74 the dams, which were entirely of earth, were opened, puddled heart-walls put in, and a waste-weir added to the first. Lake Lawson is 2¼ miles from these reservoirs and has a cap. of 120,000,009 galls., with an area of 85 acres. Water is pumped 8 ft. high from this, and then flows to the reservoirs at Moore's Bridges. The suction pipe extends 70 ft. into the lake, on a floating framework of oak and cypress timber. Water was first pumped into a wooden conduit, 12 by 18 in., but in '78 this showed signs of decay and was partially replaced by 20-in. cast-iron pipe.

In '85 Lake Lawson was pumped dry, and at present the two lakes cannot be relied upon for more than 4,000,000 galls. a day in very dry weather. From a settling basin at Moore's Bridges water is pumped direct to the city, first being aerated. No description of Lake Bradford has been given.

Tests are being made of the gang-well and other systems with a view of increasing and improving the supply, which is not only limited but also has an unpleasant odor, taste and color, in common with all surface water found in tide-water regions in Virginia.

Pumping Machinery.—*Main Station*: Dy. cap., 10,000,000 galls.; one 5,000,000-gall. Holly-Gaskill compound condensing duplex pump, bought in '86; one 1,000,000-gall. high-pressure Worthington pump, bought in '73; two 2,000,000-gall. compound Worthington pumps bought in '80. The small Worthington pump was not used in '87-8, and the other two Worthingtons only when the Holly-Gaskill pump is stopped for repairs.

Lake Lawson Station.: Dy. cap., 4,000,000 galls. One 2,000,000-gall. Worthington, and one 2,000,000 Deane high-pressure pumps, the first bought in '80 and the second in '87. There is an independent condenser for the two pumps.

Bradford Station: One 2,000,000-gall. Holly-Gaskill high-pressure pump bought in '84.

Aerating Plant.—Dy. cap., 3,000,000 galls.; placed at the main station at Moore's Bridges, in '88, by the National Water Purifying Co., New York City. Originally had an 8 by 12-in. Ingersoll compressor, which has been replaced by one 12 by 18-in., as at 60 revolutions a minute the consumption of coal was one-half that of the 5,000,000-gall. engine when pumping 3,000,000-galls. a day, while the speed necessary to work the plant to its full cap. was 130 revolutions a minute.

Distribution.—*Mains*, c. i., about 30 miles. *Services*, w. i., lead. *Taps*, 3,925. *Meters*, 70. *Hydrants*, Mathews, 126. *Gates*, Whittier, 272.

Consumption, 2,377,848 galls. *Pressure*: Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost, $795,030. Debt, $640,000; $140,000 at 5%, and $500,000 at 8%. Ann. op. exp., $15,078. Ann. rev.: consumers, $50,355; city, none.

Management.—Three Commrs. Supt., R. Y. Zachery. Registrar, Jno. R. Todd Chief Pumping Engr., Wm. Wright.

PETERSBURGH, *Dinwiddie Co.* (Pop., 21,656; est., 25,000.) On Appomattox river, on three terraces rising from the water. Has harbor for light draught vessels. Settled in 1686; incorp. a city in '50.

History.—Built in '56 by city. Engr., Henry D. Bird.

Water Supply.—Small brook, pumping from impounding to distributing reservoir.

Dam.—Forms first impounding reservoir; stone, 40 ft. high, 40 ft. thick at bottom and 5 at top.

Impounding Reservoir.—Cap., 2,664,375 galls.

Pumping Machinery.—Dy. cap., 750.000 galls.; Guild & Garrison pump. There has also been in use a 13-in. pump of 60-in. stroke made by Uriah Wells, Pittsburgh.

Distributing Reservoir.—Cap., 2,675,575 galls. The first distributing reservoir was 100 ft. above the pump, had a cap. of 300.000 galls., and was in excavation and embankment, lined with brick.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 1,080. *Meters*, none. *Hydrants*, Starr, Mathews, 110. *Valves*, Peet, Eddy.

Consumption, 750,000 galls. *Pressure*: Ordinary, 24 lbs. Fire, 60 lbs.

Financial.—Cost, $150,000. Debt, $125,000. Int., 8%. Ann. op. exp., $9,000. Ann. rev.: consumers, $12.000; city, none.

Management.—Comm. of three. Supt., J. S. Cooke. Pumping Engr., C. W. Davis.

PORTSMOUTH, *Norfolk Co.* (Pop., 11,390.) On the Elizabeth river, opposite Norfolk. Has railroad shops, manufactories and a Government Navy Yard.

History.—Construction begun in '83 by Portsmouth Water Co., and abandoned from '85 to '87, when it was taken up by Portsmouth & Suffolk Water Co., and finished in '87-8.

The original plan, as proposed by D. McN. Stauffer, New York City, was to take a temporary supply from Deep creek, five miles distant, and pump it to a tank, at an elevation of 25 ft., from which it would flow by gravity to a large pump-well near the town. Here larger pumps would force water through the distribution system, and across the Elizabeth river to Norfolk, also supplying Berkeley, which is on an island between Portsmouth and Norfolk. This would have given a sufficient supply for the three places for several years, and at a small cost, and eventually the supply main would have been extended to Lake Drummond, 19 miles from Portsmouth, which is the best water supply in the vicinity, and the source of Deep creek and also of Kilby's Lake, the present supply.

Owing to delay the Co. lost its concessions for carrying out the above plan, but was afterwards granted new concessions for a supply from Kilby's Lake, 19 miles distant, and had the works well under way with Jno. F. Ward, Jersey City, as Contr., when they were abandoned in '85. In '87 the works were bought by C. D. Ward, for a committee of the holders of the first mortgage bonds.

In '87-8 the works were finished by the Portsmouth & Suffolk Water Co. Des. Engr., Wm. E. Worthen. Const. Engr., Jos. Hastings. Contr., Jno. McNamee Brooklyn.

Suffolk will be supplied from this system in '89. It is close by the pumping station at Kilby's Lake.

Water Supply.—Kilby's Lake, pumping through stand-pipe at the lake direct to the city. The lake is 19 miles distant, and is fed from Lake Drummond.

Pumping Machinery.—Dy. cap., not given; one Gordon and Maxwell, and two Davis pumps.

Stand-Pipe.—Cap., 100,000 galls. At the pumping station, and is used as an equalizer of pressure in the long supply main.

Supply Main.—Wrought iron, 19 miles long. Laid along right of way of Seaboard & Roanoke R. R.

Distribution.—*Mains*, w. i., 31 miles, including supply main. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps* and *Meters* not given. *Hydrants*, Chapman 100. *Valves*, Chapman.

Consumption, not determined. *Pressure*: not given.

Financial.—No reliable data at hand. It is unofficially reported that the incomplete works were bought in '87 for $81,500.

Management.—Prest., Judge Hines. Secy and Treas., L. B. Ward, Jersey City, N. J. Supt., G. H. Coleman.

RICHMOND, *Henrico Co.* (Pop., 63,600; est., 85,000.) On James river at head of tide water, 151 miles from its mouth. There is good water-power at this point The city is built on a cluster of hills. Engaged in commerce and manufacturing. Settled in 1609.

History.—Built in '30 by city when population was 16,060. Engr., Albert Stein. In '82 a new pumping station was added, largely increasing the supply.

Water Supply.—James river, pumping to low and high service reservoirs.

Pumping Machiney.—Dy. cap., 24,000,000 galls. The old pumping station is near the city limits, and the new, about 2 miles distant. Nearly all the pumping is done by water-power. The total pumpage for '87 was 4,078,516,290 galls. Of this 1,072,301,000 galls. were pumped at the old, and 3,006,215,290 galls, at the new station, all but 156 437,500 galls. or less than 4% of the total being pumped by water power.

Old Station.—Dy. cap., 6,000,000 galls.

The first pump in '30 was a horizontal double acting 10-in. piston pump, of 72-in. stroke, driven by a 16-ft. breast wheel, 10 ft. wide. It lifted water to a reservoir 166 ft. above the river through 2,400 ft. of 8-in. pipe. In '34 a wheel and pump of the same size were added, and in '54 two more pumps were placed, of 12-in. bore and 72-in. stroke, also driven by breast wheels. In '73 a Jonval turbine, 9 ft. in diam., working under 10 ft. head, and two horizontal double-acting 17 in. pumps of 72 in. stroke, were added. These forced water into a new reservoir, 203 ft. above the river. As an auxiliary a Guild & Garrison steam pump of 12-in bore and 32-in stroke, was used to lift water from the James river and Kanawha canal, it being placed 43 ft. above the main station.

New Station.—Dy. cap., 18,000,000 galls. There are three "partial turbines," working under 20 ft. head, driving nine pumps with a dy. cap. of 12,000,000 galls., and a 6,000,000 gall. Worthington steam pump. The wheels and water-power pumps were designed by Prof. Chas. Smith, St. Louis, Mo., and built by H. A. Ramsay, Baltimore, Md. Water for power and supply is taken from a conduit leading from James river, and water is lifted to the high service reservoir, 161 ft. above the pumps.

Reservoirs.—Combined cap., 49,250,000 galls.

Marshall Low Service.—Cap., 9,250,000 galls. Built about '31, and enlarged in '44, in two compartments, with an original water surface, for each, 104 by 194 ft., and a depth of 10.7 ft. A gravel filter-bed was built for each division, but apparently did not work well. Embankments were of earth, with puddle core in center. The slopes were lined with one course of brick on edge, laid diagonally on the slope. The bottom was paved with brick laid flat in lime mortar. In '44 the embankments were raised 6 ft., making the water surface 256 by 382 ft., at 166 ft. above the pumps. In '76 it was reported that there was 6 ft. of mud on the bottom of the reservoir, which could not be removed by drainage. The influent and effluent pipes pass through the banks with no gate-houses.

High Service Reservoir.—Cap., 40,000,000 galls. Built in '74-5, has earth embankments, and is in two divisions. Each division has a water surface of 416 by 426 ft., and a depth of 20 ft. Inner slopes are 2 to 1, lined with one course of brick on edge in mortar, and the bottom is covered with 6 in. of concrete. The influent and effluent chambers communicate with either division, and there is a settling space between the lower outlet and the bottom, with arrangements for draining out the sediment.

Distribution.—*Mains*, c. i., 73.4 miles. *Services*, lead. *Taps*, 8,900. *Meters*, 66. *Hydrants*, Ludlow, Tanner & Delaney, 430.

Consumption, 11,133,017 galls. *Pressure*: Ordinary, 41 lbs. Fire, 41 lbs.

Financial.—Cost, unknown, but est. value is $1,500,000. Debt and int., not given. Ann. op. exp., $30,368. Ann. rev.: consumers, $111,024.

Management.—Water Comm. of nine. Chairman, A. L. Owen. Supt., C. E. Bolling. Asst. Supt., E. E. Davis, Pumping Engr., J. C. Boyden.

ROANOKE, *Roanoke Co.* (Pop., est., 10,000.) In an agricultural and mining region Has tobacco factories, car shops, iron and locomotive works.

History.—Built in '84 by Roanoke Water Co. Engr., Howard Murphy, Philadelphia. In '87-8 two reservoirs were built and a new pump bought. Contr. for building, P. F. McArdle.

Water Supply.—Spring on Mill mountain, pumping to reservoir, and direct pumping when necessary. Pumping direct and to tank was used until '88 but the tanks have been abandoned.

Pumping Machinery.—Dy. cap., 4,000,000 galls. Holly Mfg. Co. put in pumps and boilers.

Reservoirs.—Two, on Mill mountain above spring; cap., 2,500,000 galls. A serious break in the bottom of the reservoir was reported in '88. The work was done by the Co.

Distribution.—*Mains*, 4 to 16-in. c. i., 12 miles. *Services*, galv. i. *Taps*, 1,157. *Meters*, none. *Hydrants*, Mathews, 66. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 125 lbs. Fire, 125 lbs.

Financial.—Cost, $250,000. Capital stock, $250,000. No debt. Ann. op. exp., $5,000. Ann. rev.: consumers, $16,000; city, $1,200. Hydrant rental, $25.

Management.—Prest., Jas. J. Doran, Philadelphia. Secy. and Treas., H. E. Gerhard, Philadelphia. Supt., C. O'Leary. Pumping Engr., Wm. T Lockett.

SALEM, *Roanoke Co.* (Pop., 1,759; est., 2,300.) Near Roanoke river in a valley on a spur of the Blue Ridge. Has some manufactories. Incorp. a town in '32.

History.—Built in '75-6 by town after plans by L. Morrison.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 60,000 galls.; Guild double-acting water-power pump.

Reservoir.—Cap., 250,000 galls.: is 185 ft. above town, excavated in clay and lined with brick in cement.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, 200. *Meters*, none *Hydrants*, kind not given, 30.

Consumption, 40,000 galls. *Pressure*: 185 ft. head.

Financial.—Cost, $12,718. Bonded debt, $10,500. Int., 6%. Ann. op. exp., $265 Ann. rev.: consumers, $1,000; city, none.

Management.—Town Council. Supt., J. B. Boon.

STAUNTON, *Augusta Co.* (Pop., 6,664; est., 7,000.) On an elevated plateau in the Blue Ridge mountains, about 1,450 ft. above the sea. The ground slopes 25 ft to the mile. Engaged in manufacturing. Settled before 1738; incorp. a city in '71.

History.—Built in '76-7. Engr., Donald Allan. Contrs., Menefee & Parkins, Staunton. Sub-Contrs.: for masonry, McMahon & Keefe; for brick-work of buildings, Jordan & Shumate, and for wood work, W. T. Marr.

Water Supply.—Ten springs in limestone, connected by about 2 miles of 4 to 16-in. stoneware pipe laid in cement, then pumped to reservoir.

Pumping Machinery.—Dy. cap. not given; one Worthington compound duplex, and one Deane pump. The lift is 182.6 miles.

Reservoir.—Cap., 2,500,000 galls.; is 210 ft. in diam. at top and 183 ft. at bottom.

Distribution.—*Mains*, 12 to 4-in. c. i., 13 miles. *Services*, w. i. Pipe and specials furnished by Tredegar Co., Richmond. *Taps*, about 1,200. *Meters*, 2. *Hydrants*, kind not given, about 50.

Consumption, 880,000 galls. *Pressure*: Fire, 110 lbs.

Financial.—Cost., 100,000. Debt, $80,000. Int., 8%. Ann. op. exp., $2,500. Ann. rev.: total, $10,000.

Management.—Water Comm, of three. Chairman, C. Bargamin. Secy., Newton Argenbright. Supt., Jno. T. Long. Pumping Engr., Leo. W. Fisher.

TAZEWELL, *Tazewell Co.* (Pop., est., 900.) Near head waters of Clinch river in an agricultural and grazing district.

History.—Built in '86-8 by village. Const. Engr., Jas Allen, Lynchburg.

Water Supply.—Spring, by gravity. The spring is about 1½ miles from the village, and 320 ft. above the court house. A 2-in. pipe, 2,475 ft. long, conducts water to the reservoir.

Reservoir.—Cap., 35,000 galls. Is of stone masonry, 26 ft. in diam. at top, 22 ft. at bottom, 11 ft. deep, and 170 ft. above the town. A 4-in. c. i. main extends from the rseervoir to the town, and through Main street. Cost, $780. Contr., D. J. Phipps, Tazewell.

Distribution.—*Mains*, 4-in. c. i., 1.3 miles. *Services*, ½ in. w. i. Pipe and specials furnished by Glamorgan Co., Lynchburg. Trenching done by W. S. Brown and Geo. Foss, Tazewell, and pipe laying superintended by Jas. Allen. *Taps*, 11. *Meters*, none. *Hydrants*, Galvin, 7; also 5 service hydrants, made by Jarecki, Hayes & Co., Erie, Pa.

Consumption, not determined. *Pressure*: not given.

Financial.—Cost, $4,500. Ann. op. exp., $75. Ann. rev.: consumers, $396.

Management.—Supt., G. L. McClintock. Report made by Emile Low.

UNIVERSITY OF VIRGINIA, *Albermarle Co.* (Pop., 650.) Near Charlottesville. Founded in '25.

History.—Built in '58, and new works built in '68. Engr. for first, Chas. Ellitt; for second, Geo. Peyton. In '86 the University and the City of Charlottesville built a reservoir five miles from the University, and laid pipe to connect with the former distribution. The University paid about $25,000 for its part of the work.

The former supply was from a reservoir in the mountains, two miles distant, which was filled by springs and surface water. A dam 20 ft. high and 100 ft. long on top was built across a ravine. It consisted of two walls of brick in cement mortar 6 in. apart, filled between with beton. The cap. of the reservoir was 2,000,000 galls., and it was from 70 to 100 ft. above the University grounds. A 5-in. c. i. main extended one mile from the reservoir to the grounds. Before '68 a No. 5 Worthington pump lifted water to tanks of 30,000 galls. cap., placed 60 ft. above the highest grounds. The tanks were retained.

See Charlottesville for description of Water Supply and Reservoir.

Distribution.-Arranged to supply the University grounds and buildings. There are about 60 taps. *Pressure*: about 100 lbs.

Financial.—In '81 the works had cost $28,132, and the improvements in '86 cost about $25,000. Ann. op. exp., $125, No rev.

Management.—Supt., Geo. Peyton.

WINCHESTER, *Frederick Co.* (Pop., 4.958; est., 5,000.) On broken ground in Shenandoah valley, 33 miles from Washington. Has paper, sumach and flouring mills, foundries and shoe and glove factories. Settled in 1752; incorp. in 1779.

History.—Built in '81 by town.

Water Supply.—Spring, ¼ mile from and 50 ft. above village, by gravity.

Distribution.—*Mains*, c. i., 8 miles. *Services*, not given. *Taps*, about 550. *Meters*, none. *Hydrants*, kind not given, 50.

Consumption and *Pressure*, not given.

Financial.—Cost and debt, not given. Ann. op. exp., $500. Ann. rev.: for year ending May 1, '82, $3,000.

Management.—Supt., Jno. H. Nulton.

Water-Works Projected with Fair Prospects of Construction.

BERKLEY, *Norfolk Co.* (Pop., not given.) On island in Elizabeth river, between Norfolk and Portsmouth.

Proposed System.—There has been talk of contracting for a supply from the Portsmouth and Suffolk Water Co., of Portsmouth. No agreement had been made Nov. 12, '88. Address G. H. Coleman, Portsmouth.

COVINGTON, *Alleghany Co.* (Pop., 436; est., 1,000.) In center of iron region.

Proposed System.—The Covington Water Co. propose to take water from a mountain stream, by gravity, building a small reservoir. Est. cost, $12,000 to $14,000. Capital for construction partly secured in Sept., '88. Address E. M. Nettleton, or the Engr., W. S. Hungerford.

FARMVILLE, *Prince Edward Co.* (Pop., 2,058; est., 2,500.) On Appomattax river, in mining district. Has several tobacco factories.

Proposed System.—The Farmville Water Co. propose pumping from creek, 5 miles distant, to a reservoir 120 ft. above town. Est. cost, $40,000 to $45,000. An attempt is being made to have the town guarantee $35,000 of bonds and to raise $10,000 by private subscriptions. Also to have the town contract for 40 hydrants at $2,100. Address, A. R. Venable, Jr.

Present Supply.—Springs, wells and 11 cisterns.

PULASKI CITY, *Pulaski Co.* (Pop., est., 1,800.) In timber, coal and zinc region.

Proposed System..—The Pulaski Water Supply Co. propose to pump water from artesian wells to reservoir. Capital for construction had been secured in Feb., '88, and work was to begin in July and be finished in '88. Two wells have been sunk but nothing further done up to Nov., '88. Engr., M.J. Alexander, Pulaski City. Prest. of Co., Wm. C. Bullit, Philadelphia. Report made by former.

SUFFOLK, *Nansemond Co.* (Pop., est., 2,500.) On Nansemond river, 17 miles from Portsmouth and 2 miles from Kilby's lake, the source of Portsmouth water supply.

Proposed System.—To be supplied by the Portsmouth & Suffolk Water Co., in '89, whose pumping station is near by, and whose supply main passes through or near the town. Address G. H. Coleman, Portsmouth.

WARRENTON, *Fauquier Co.* (Pop., 1,464; est., 2,000.)

Proposed System.—No definite information given, but water-works are wanted by the citizens. Address R. R. Campbell.

WYTHEVILLE, *Wythe Co.* (Pop., 1,885; est., 3,000.) Engaged in manufacturing.

Proposed System.—The town has authorized a loan of $60,000 coupon bonds, running 34 years at 6%, to be secured by first mortgage on the proposed water-works. To June 21, nothing further had been done as the town would not sell the bonds at less than par, and could find no purchasers at those terms. Report by H. I. Wadley.

WEST VIRGINIA.

Water-Works Completed or in Process of Construction.

CHARLESTON, *Kanawha Co.* (Pop., 4,192; est., 8,000.) On Great Kanawha and Elk rivers, on slightly undulating ground. The Great Kanawha river is navigable for 25 miles above the city. In coal and iron region.

History.—Built in '85-6 by Charleston Water-Works Co., under a 20 years' franchise. Engr., E. R. Davenport.

Water Supply.—Elk river, by direct pumping, water being admitted through inlet pipe to suction basin, and pumped through filter to city when water is muddy. The river is a mountain stream, generally clear.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two 1,500,000-gall. Deane pumps, and two Ward boilers. The pumps have 14 and 20-in. steam, and 12-in. water-cylinders, of 18-in. stroke. Each pump has a Mason patent regulator.

Filter.—Hyatt, dy. cap., 500,000 galls.

Distribution.—*Mains*, 4 to 16-in. kalamein i., 13 miles. *Services*, kalamein i. *Taps*, 700. *Meters*, 2. *Hydrants*, Ludlow, 60. *Valves*, Ludlow. *Pressure gauge*, Edson.

Consumption, 450,000 galls. *Pressure*: Ordinary, 40 to 45 lbs. Fire, 80 lbs.

Financial.—Cost, $126,500. Capital stock, $42,000. Bonded debt, $84,500. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $9,090; city, $2,500 for 60 hydrants, or $41.66 each.

Management.—Prest., J. H. Brown. Secy., W. S. Laidley. Supt. and Treas., Frank Woodman. Pumping Engr., Mordecai Levy.

CLARKSBURGH, *Harrison Co.* (Pop., 2,037; est., 8,000.) In Clark and Coal townships, in coal region. Has manufactories.

History.—Built in '88 by town. Engr., Jno. W. Hill, Cincinnati, O.

Water Supply.—West fork of Monongahela river, pumping to tanks.

Pumping Machinery.—Dy. cap., 500,000 galls.; two compound duplex direct-acting Deane pumps, lifting against 340 ft. head.

Tanks.—Cap., 560,000 galls.; two 280,000-gall. steel tanks, 40 ft. in diam. by 30 ft. deep, furnished by Cox & Morrison, Wheeling.

Distribution.—*Mains*, c. i., 6.5 miles. Pipe and specials furnished R. D. Wood & Co., Philadelphia, Pa., and trenching and pipe-laying done by R. B. Carothers, Newport, Ky. *Hydrants*, Bourbon Copper & Brass Works, 51. *Valves*, Eddy.

Pressure: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $50,000. Bonded debt, $50,000. Int., 5%.

Management.—Three Commrs.; R. T. Lowndes, T. M. Jackson and J. B. Hart.

NOTE:—Complete data cannot be given until works have been longer in operation.

GUYANDOTTE, *Cabell Co.* (Pop., 19; est., 1,200.) On Guyandotte river, joining Huntington.

History.—Built in '88 by Guyandotte Water Co., which is controlled by American Water-Works & Guarantee Co., Limited, Pittsburgh, Pa. An extension of the Huntington works.

Water Supply.—Ohio river, from reservoir filled by pumps at the Huntington works.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 4 miles.

Financial.—Capital stock, $50,000. Bonds, $25,000. Int., 6%.

NOTE.—Complete data not determined at time of report. See Huntington.

HUNTINGTON, *Cabell Co.* (Pop., 3,174; est., 8,000.) On Ohio river. Has large car and other manufactories, and extensive shipping business.

History.—Built in '87 by Huntington Water Co., and managed by American Water-Works & Guarantee Co., Limited, Pittsburgh, Pa. Supplies water to Guyandotte.

Water Supply.—Ohio river, filtered, by direct pumping.

Pumping Machinery.—Worthington, dy. cap., 3,000,000 galls.

Filter.—Hyatt, dy. cap., 400,000 galls.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. Pipe and specials furnished by Addyston Pipe & Steel Co., Cincinnati, O. *Taps*, 326. *Meters*, not given. *Hydrants*, Ludlow, 84. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $90,000. Capital stock, $100,000. Bonds, $75,000. Int., 6%. Ann. op. exp. and rev., withheld.

Management.—Genl. Mgr., Wm. S. Kuhn, Pittsburgh, Pa. Supt., W. W. Cunningham.

MARTINSBURGH, *Berkeley Co.* (Pop., 6,335; est., 7,500.) On small tributary of Potomac river, in rolling country. Has railroad repair shops, distillery, spoke works, and lime and phosphate factories. Laid out in 1732.

History.—Built in '73-4 by city.

Water Supply.—Springs, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls. Four Holly water-power pumps, of 7½-in. bore and 22-in. stroke, with a supplemental steam pump and a rotary pump, horizontal tubular boiler, 5 by 16 ft.

Distribution.—*Mains*, w. i. and cement, 6.5 miles, *Services*, w. i. *Taps*, 650. *Meters*, none. *Hydrants*, Holly, 52. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $85,000, Debt, $85,000. Int., 5%. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,500; city, none.

Management.—Water Board of five from City Council. Supt. and Pumping Engr., J. M. Schaffer.

PARKERSBURGH, *Wood Co.* (Pop., 6,582; est., 10,000.) On Ohio and Little Kanawha rivers. Has two lines of pipe to oil region, oil refineries, foundries and machine shops, lumber and flour mills, and is a general shipping center.

History.—Built in '85 by city. Engr., Jno. W. Hill, Cincinnati, O. Contr. for masonry, M. Rush; for buildings, Herman Fouse.

Water Supply.—Ohio river, pumping to tanks.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Wilson, Snyder & Co. pump.

Tanks.—Cap., 2,000,000 galls.; two 1,000,000-galls. iron tanks, made by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky. Trenching and pipe laying done by W. N. Ayers. *Taps*, 680. *Meters*, none. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Consumption, 36,500 galls. *Pressure*: At pump, 72 to 96 lbs. Fire, 68 to 90 lbs.

al.—Cost, $106,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $9,500. The city advanced $26,500 in cash, without int., and this offsets the sum usually paid for hydrant rental.

Management.—Clerk, L. W. Hughes. Supt., Chas. F. Bryan.

WELLSBURGH, *Brooke Co.* (Pop., 1,815; est., 3,000.) On Ohio river, 16 miles from Wheeling.

History.—Built in '86 by town. Des. Engr., B. W. Peterson, Wheeling, W. Va. Const. Engr., D. McClelland, Wellsburgh. Contr. for masonry, Jos. Gano, Wellsburgh; for buildings, W. B. Peterson, Wheeling.

Water Supply.—Ohio river, pumping to reservoir and direct.

Pumping Machinery.—Knowles compound duplex pump, dy. cap., 600,000 galls.; tubular boiler furnished by Cox & Morrison, Wheeling.

Reservoir.—Cap., 300,000 galls. Contr., W. T. Nichols & Co., Wellsburgh.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by Redman & Bro., Wellsburg. *Taps*, 150. *Meters*, none. *Hydrants*, Mathews, 23. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $25,000. Bonded debt, $25,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,800.

Management.—Water Board of three. Supt., N. Nelson. Report by E. A. Sheets.

WHEELING, *Ohio Co.* (Pop., 30,737; est., 35,000.) On east bank of Ohio river and Zanes island in the river, on bottom land where Wheeling creek empties into the river. Hills rise on the east from 250 to 600 ft. Has steel, iron, nail, pottery and flint glass and other manufactories. In bituminous coal and natural gas region, the latter being used for fuel. Settled in 1782; incorp. a city in '36.

History.—Built in '31-4 by town.

Water Supply.—Ohio river, pumping to reservoir. The first suction pipes were laid 100 ft. into the river and perforated near the ends with 1-in. holes.

Pumping Machinery.—Dy. cap., 11,000,000 galls. In '82 the pumping machinery consisted of two side-lever engines, with 20-in. cylinders and 84-in. stroke, driving double-acting 16-in. pumps of 120-in. stroke, the engine making two strokes to one of the pump. Also a Worthington duplex high-pressure pump, of 29-in. steam and 15-in. water-cylinders, of 36-in. stroke, placed in '80. In '83 a new pumping station was built and two Gordon & Maxwell double-acting vertical pumps added.

Reservoirs.—*Old*: Cap., 880,000 galls.; on rock with solid masonry walls. Is 190 ft. above pumps, 150 ft. above lowest part of town, but from 25 to 50 ft. below many residences on the hill. Every year from 18 to 24 in. of sediment is removed from its bottom.

New: Contracts were let in '88 to W. M. Chisholm, East Liverpool, O., for a 3,000,000-gall. reservoir, about 50 by 665 ft., by 11½ ft. deep. Contract price, $30,000.

Distribution.—*Mains*, c. i., 41 miles. *Services*, lead. *Taps*, 6,900. *Meters*, none. *Hydrants*, principally Ludlow, with a few Mathews.

Consumption, 4,500,000 galls. *Pressure*: 45 lbs.

Financial.—Cost, $750,000. No debt. Ann. op. exp., $27,500. Ann. rev.: consumers, $58,000; city, none.

Management.—Water Board of four. Prest., Wm. Hastings. Secy., H. P. Wilkinson. Supt., Jas. H. Riddle. Pumping Engrs., Jno. Andrews and Nathan Kuhn.

Water-Works Projected with Fair Prospects of Construction.

HINTON, *Summers Co.* (Pop., est., 1,600.) On New river in timber and coal region.

Proposed System.—The town has voted $10,000 towards water-works estimated to cost $20,000, water to be pumped from New river to reservoir. Address Jas. Prince, Recorder.

Present Supply.—Wells, cisterns, and hauling from river.

NORTH CAROLINA.

Watet-Works Completed or in Process of Construction.

ASHEVILLE, *Buncombe Co.* (Pop., 2,616; est., 8,000.) Is 2,500 ft. above the sea, one mile from French Broad river, and two miles from Swannanoa river. Both streams are 250 ft. below the town, and the surrounding mountains are from 300 to 4,500 ft. above it. Has manufactories. Settled in 1795.

History.—Built in '83-7 by city. In '83 a gravity system was built after plans by A. Seversedge, and with C. L. Freeman as Const. Engr. The system was afterwards extended, the work being finished in '87. Des. Engr., Ernest W. Bonditch, Boston, Mass. Contrs. Engr., Ed. D. Bolton, Boston, Mass. Contrs. for masonry, Murdock & Colvin, Asheville.

Water Supply.—Springs, surface water, and Swannanoa river, by gravity and pumping to stand-pipe. The first supply was from springs and streams having a drainage area of 20 sq. m. Pumping from the river was introduced with the later extensions.

Conduit.—For the gravity supply the water of each spring or stream was received in a brick chamber, and brought to a 6-in. earthenware pipe leading to the reservoir, about 2½ miles. Brick silt chambers with blow-offs and over-flow weirs were put in every 1,000 ft.

Reservoir.—Cap., 300,000 galls.; excavated in rock, lined with cement, and is 150 ft. above the city.

Pumping Machinery.—Dy. cap., 720,000 galls.: Gordon & Maxwell duplex pump, driven by turbine water-wheel.

Dstribution.—*Mains*, c. i., 10 miles. *Services*, iron. Pipe and specials furnished by Chattanooga. (Tenn.) Foundry & Pipe Works, and trenching and pipe-laying done by Cole & Gillett, Norfolk, Va. *Taps*, about 300. *Meters*, none. *Hydrants*, Ludlow, 45. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. No debt. Ann. op. exp., $600. Ann. rev.: consumers, $3,000; city, none.

Management.—Supt., F. M. Miller. Machinist, J. H. Boardman.

CHARLOTTE, *Mecklenburgh Co.* (Pop., 7,094; est., 12,000.) On Sugar creek on undulating ground. Manufactures carriages, farm implements, cotton goods, tobacco, machinery and iron castings. Settled in 1762; incorp. a city in '50.

History.—Built in '81-2 by Charlotte City Water-Works Co. Des. Engr., E. S. Soper. Const. Engr., Garwood Ferris.

Water Supply.—Springs, pumping from impounding reservoir to stand-pipe.

Reservoir and Dam.—Cap., est., 10,000,000 galls.; a clay dam with timber heart forms a reservoir 600 by 150 ft., and 16 ft. deep, 120 ft. below the city.

Pumping Machinery.—Dy. cap., not given; one duplex and one high-pressure Blake pump.

Stand Pipe.—Is 18 ft. in diam. and 110 ft. high.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. *Taps*, not given. *Meters*, 12. *Hydrants*, kind not given, 89.

Consumption, 250,000 galls. *Pressure*: Ordinary, 48 lbs. Cost not given. Capital stock, $100,000. Bonded debt, $140,000, Int., 6%. Ann. op. exp., $1,400, Ann. rev.: consumers, not given: city, $3,115. Hydrant rental, $35.

Management—Prest., Dr. A. J. Brevard. Treas., E. B. Springs. Supt. and Secy., D. P. Hutchison.

DURHAM, *Durham Co.* (Pop., 3,614; est., 8,000.) Is 25 miles from Raleigh, and said to have the most extensive tobacco factories in the world.

History.—Built in '86-7 by Durham Water Co., under exclusive franchise for 20 years. Des. Engr. and Contr., A. H. Howland. Const. Engr., Geo. A. Ellis, both of Boston, Mass.

Water Supply.—Eno river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Deane pumps and tubular boilers.

Reservoir.—300 ft. in diam., by 15 ft. deep.

Distribution.—*Mains*, c. i., 13.4 miles. *Services*, lead. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington. N. J. *Taps*, 109. *Meters*, 8. *Hydrants*, Coffin, 87. *Gates*, Chapman. *Pressure Gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 72 lbs. Fire, 100 lbs.

Financial.—Cost. $240,000. Capital stock, $125,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, withheld; city, $3,860. Hydrant rental, $3,500 for hydrants on first 6 miles of pipe, and $45 for each additional.

Management.—Prest. and Supt., S. W. Holman. Treas., A. H. Howland, Boston,

YETTEVILLE, *Cumberland Co.* (Pop., 3,485; est., 5,006.) On Cape Fear river at head of navigation. Manufactures cotton goods and is a shipping point for lumber, tar, turpentine and cotton. Settled about 1750.

History.-Built in '29 by private Co. and leased in '75 by S. W. Tillinghast, known as Fayetteville Water-Works Co. An attempt has lately been made by the town to build works.

Water Supply.—Spring, about 30 ft. above general level of town, by gravity, to and from brick reservoir.

Reservoir.—Cap., 6,000 galls.

Distribution.—*Mains*, wooden, 3-in. bore, 2 miles. *Services*, galv. i., wood, rustless iron. *Taps*, 100. *Meters*, none. *Hydrants*, 9.

Consumption, 86,000 galls. *Pressure*: Ordinary; 15 lbs.

Financial.—Cost. $4,500. Capital stock. $5,000. Ann. op. exp., $500. Ann. rev.: consumers,, $1,000; city, none.

Management.—Supt., S. W. Tillinghast.

GREENSBOROUGH, *Guilford Co.* (Pop., 2,105; est., 5,000.) In Gilmer and Morehead townships. Has manufactories.

History.—Built in '87-8 by Greensborough Water Co. Engr., W. W. Taylor. Work done by Co.

Water Supply.—Wells and springs, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake pump, and Babcock & Wilcox boiler.

Tank.—Cap., 100,000 galls.; on brick tower, its top being 100 ft. high.

Distribution.—*Mains*, c. i., about 10 miles. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps* and *Meters*, not determined. *Hydrants*, Mathews, 75. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs. Fire, 75 lbs.

Financial.—Cost, $75,000. Capital stock, $75,000. Bonds, $50,000. Int., not given. Ann. op. exp., and rev.: not determined. Hydrant rental, contract price, $28.75 for 75 and $35 for each additional.

Management.—Prest., Thos. B. Keogh. Secy. and Treas., Fred B. Hubbell, 1225 Calvert street, Baltimore, Md.

RALEIGH, *Wake Co.*, (Pop., 9,265; est., 15,000.) An important trade center in cotton, corn and tobacco region.

History.—Built in '87 by Raleigh Water Co. Engr., M. M. Moore, 112 Liberty St., New York City. Contr., National Water-Works Construction Co. Dayton, O.

Water Supply.—Walnut creek, 1¾ miles from city. pumping to tank, with direct pumping for fire protection. Water is filtered.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; four 1,000,000-gall. Smith & Vaile pumps two 40 H. P. boilers. and two turbine water wheels. Filter, Hyatt, dy. cap., 300,000 galls.

Tank.—On 90 ft. of masonry, 23 ft. in diam. and 30 ft. high. Contrs., R. M. Mitchell & Co., and P. Lincoln & Co., Raleigh.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. Pipe and specials furnished, by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 187. *Meters*, 14. *Hydrants*, Mathews, 120. *Valves*, Eddy.

Consumption, 112,000 galls. *Pressure*: 50 to 90 lbs.

Financial.—Cost, not given. Capital stock, $100,000. Bonded debt, withheld. Ann. op. exp., $14,000. *including interest on bonds*, not given. Ann. rev.: consumers withheld; city, $4,480. Hydrant rental, $37.50, a 20 years' contract.

Management.—Prest., Julius Lewis. Treas., W. W. Smith. Supt., E. B. Engelhard.

SALEM, *Forsyth Co.* (Pop., 1,340; est., 3,500.) On middle fork of Muddy creek, on irregular ground. Has cotton, saw, grist and planing mills, and iron works. Settled in 1760; incorp. in '54.

History.—Built in 1800, and new works built in '78 by Salem Water Supply Co. The first works consisted of cisterns, located about the town, filled by a force pump.

Water Supply.—Two wells, pumping to reservoir. The wells are 10 ft. in diam., and near a creek. One has a cap. of 40, and one of 50 galls. a minute.

Pumpig Machinery.—Worthington pump, dy. cap., about 150,000.

Reservoir.—Cap., 450,000 galls. Contrs., D. W. C. Carroll & Co.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 85. *Meters*, 80. *Hydrants*, kind not given, 32.

Consumption, est., 30,000 galls. *Pressure*: Ordinary, 80 lbs.

Financial.—Cost, $16,500. Capital stock, $8,000, Debt, $6,250. Int., 6%. Ann. op. exp., $150. Ann. rev.: consumers, $1,200; city, none, as it furnishes its own hydrants.

Management.—Prest., Frank H. Fries. Secy., S. M. Clinard. Supt., C. A. Fogle

SALISBURY, *Rowan Co.* (Pop., 2,723; est., 5,000.) Has iron foundries and various manufactories.

History.—Built in '87 by Moffett, Hodgkins & Clarke, Watertown, N. Y., who were Engrs. and Contrs.

Water Supply.—Springs, pumping to tank.

PumpingMachinery.—Not described.

Tank.—Not described.

Distribution.—*Mains*, c. i., 7.5 miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 58.

Consumption, 25,000 galls. *Pressure*: Ordinary, 78 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $85,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $2,500. Hydrant rental, about $40.

Management.—V. Prest. and Engr., E. H. Burlingame.

WESTERN NORTH CAROLINA INSANE ASYLUM, *Morgantown, Burke Co.* (Pop., 550.)

History.—Built in '76 by State. Engr., Roger P. Atkinson.

Water Supply.—Black Fork branch of Catawba river, by gravity from impounding reservoir, 4.7 miles from asylum.

Dam.—Forms reservoir, built across a mountain gorge; is 60 ft. long, 8 ft. high, of coursed rubble masonry on a footing of concrete 2 ft. thick and 2 ft. below bed of stream. Backed with riprap, and has earth embankments at each end. There is a chamber in the dam, 3 ft. sq., from which a 6-in. pipe leads to the Asylum.

Reservoir.—Cap., 100,000 galls.; is 40 by 125 ft., by 6 ft. deep, and 177.5 ft. above the Asylum.

Supply Main.—Follows undulations of surface, not rising above hydraulic grade, but at one point is 200 ft. below reservoir. Air-cocks are placed at summits and blow-offs at depressions.

Ordinarily the pipe trenches were 2½ ft. deep. Joints were made by springing in the pipe, there being no sleeves. At each joint 5 lbs. of lead and 0.6 lbs. of oakum were used.

Distribution.—*Mains*, c. i., 4.8 miles. *Services*, galv. i. No taps, meters or hydrants.

Consumption, 75,000 galls. *Pressure*: 67 lbs.

Financial.—Cost, $23,000. No debt. Ann. op. exp., $150. No rev.

Management.—Engr. of Asylum, H. R. Hicks.

NOTE:—A detailed account of cost of pipe-laying is given in *Engineering News*, vol. IX., p. 429.

WILMINGTON, *New Hanover Co.* (Pop., 17,350; est., 23,000.) On a bluff on east bank of Cape Fear river, at head of navigation, 30 miles from the ocean. Manufactures cotton goods, naval stores, and machinery, and has extensive commerce. Settled about 1750.

History.—Built in '81-2 by Clarendon Water-Works Co. Contr., J. A. Cloud.

Water Supply.—Cape Fear river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two duplex and one compound duplex Worthington pumps.

Stand-Pipe.—Is 20 ft. in diam. and 80 ft. high; furnished by C. H. Delameter & Co.

Distribution.—*Mains*, c. i., 13.1 miles. *Services*, galv. w. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 486. *Meters*, 120. *Hydrants*, Chapman, 105 public, and 19 private. *Valves*, Chapman.

Consumption, 427,431 galls. *Pressure*: Ordinary, 47 lbs. Fire, 100 lbs.

Financial.—Cost, $191,000. Capital stock, $100,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $6,300. Ann. rev.: consumers, $7,300; city, $6,750. Hydrant rental, $70 for first 75 and $50 for next 30.

Management.—Prest., J. F. Divine. Treas., Geo. W. Kidder. Supt. and Engr., J. C. Chase.

WINSTON, *Forsyth Co.* (Pop., 2,854; est., 8,000.) On Piedmont range of mountains, 1,000 ft. above the sea. Has large tobacco manufactories, an iron foundry, cotton and woolen mills.

History.—Built in '81-2 by Winston Water Co., under a 99 years' franchise. Des. Engr., J. W. Andrews. Const. Engr., Geo. W. Hinshaw.

Water Supply.—Well, pumping to reservoir. The well is 15 ft. in diam., 30 ft. deep, and has a brick wall 2 to 2½ ft. thick, the upper portion being laid in cement.

Pumping Machinery.—Dy. cap., 220,000 galls.; Worthington water-power pump, with boiler and engine for supplementary power. The pump-well is near a small stream, across which a dam is built, giving power to drive an overshot wheel.

Force Main.—Wrought iron, 3,000 ft. of 6-in. pipe rising 210 ft.

Reservoir.—Cap., 1,000,000 galls.; 79 by 78 ft., by 21½ ft. deep, and is 16 by 65 ft. above residence, 40 to 100 ft. above business section, and 210 ft. above pump. Walls are of brick, laid in Portland cement, 11 ft. thick at base, and battered on the outside from the surface of the ground to within 5 ft. of the top, from which point to the coping they are perpendicular, and 3 ft. thick.

Distribution.—*Mains*, c. i., 4¾ miles. *Services*, w. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 140. *Meters*, 50. *Hydrants*, Mathews, 45. *Valves*, Eddy.

Consumption, 120,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 15 to 45 lbs.

Financial.—Cost, $52,000. Capital stock, $19,000. Total debt, $31,000: Bonds, $24,000 at 8%; floating, $7,000 at 6 and 8%. Ann. op. exp., $1,027. Ann. rev.: consumers, $2,887; city, $1,125. Hydrant rental, $25, a 20 years' contract from '80.

Management.—Prest., Thos. J. Wilson. Supt., Secy. and Treas., Geo. W. Hinshaw.

Water-Works Projected with Fair Prospects of Construction.

GOLDSBOROUGH, *Wayne Co.* (Pop., 3,286; est., 5,000.) On Neuse river, in agricultural region. Has manufactories.

Proposed System.—City awarded franchise and contract to a party, name not given, in '87 or early part of '88, but as late as Nov., '88, nothing had been done. Works are desired. The proposed supply was by pumping from Little river to stand-pipe at an estimated cost of $75,000. Report by City Clerk, T. H. Bain.

Present Supply.—Cisterns.

HENDERSON, *Vance Co.* (Pop., 1,421; est., 4,000.) In tobacco, cotton and general agricultural region, 500 ft. above the sea.

Proposed System.—The Henderson Water-Works Co. was chartered early in '88, proposing to pump water from a stream. Prest. of Co., J. R. Young.

Present Supply.—Wells and cisterns.

HENDERSONVILLE, *Henderson Co.* (Pop., 554; est., 1,600.) Manufactures furniture, carriages and brooms.

Proposed System.—In Feb., '88, the town had voted and placed on sale $20,000 of bonds, and intended to have works finished in July, '88. No later data can be obtained.

Water was to be taken from Echo brook, by gravity from an impounding reservoir two miles from and 267 ft. above the town. Engr., Jas. Anderson. Chairman Water Board, J. P. Rickman. Report by Jas. P. Davis.

Present Supply.—Wells and springs.

OXFORD, *Granville Co.* (Pop., 1,349; est., 4,000.) Has tobacco manufactories. **Proposed System.**—The Oxford Electric Light, Power & Water Co., propose to pump water from a large well, Tar river, or Fishing creek, at a cost of $25,000 for complete system.

The town will guarantee interest on bonds. Capital for construction had not been fully secured in June,'88, but it was expected that contracts would be let in the fall. Prest., H. C. Heraden. J. A. Williams can give information.

Present Supply.—Private wells.

Water-Works Projects Reported in '87 and '88 but Now Indefinite.

Helton, *Ashe Co.*; Southern Pinos, *Moore Co.*; Tarborough, *Edgecombe Co.*; Washington, *Beaufort Co.*

SOUTH CAROLINA.

Water-Works Completed or in Process of Construction.

CHARLESTON, *Charleston Co.* (Pop., 49,984; est., 60.000) At junction of Ashley and Cooper rivers, 7 miles from the ocean, with fine harbor and large foreign and domestic commerce. The streets are somewhat irregular, as tidewater, creeks and ponds and marshy spots formerly covered a portion of the thickly settled part of the city, which is now from 8 to 12 ft. above high-water. As early as 1680 there was a settlement here called "Charles Town." In 1783 it was incorp. as Charleston.

History.—Built in '76-80, and now owned by City of Charleston Water-Works Co.

Since '24 five attempts have been made to obtain good water from artesian wells. The first of which description is given was in '48, when Major Wilton began boring at the corner of Wentworth and Meeting streets. Quicksand sometimes filled the tubing 150 ft. in a night. In '61 work on this well was discontinued at a depth of 1,250 ft., tubed with 6-in. pipe at top, and 3-in. at bottom. The well discharged 25,000 galls. a day at 88 degrees Fahrenheit, the water being strongly impregnated with sodium and magnesium. In '81 a few bath-rooms were supplied from it, the rest of the water running to waste.

In '76 F. Spangler began boring a well which proved successful, and in '79 the City Council made a contract for works with Jesse W. Starr. The system was partly completed in '80 but the contractor not fulfilling agreements his contract was annulled and in Jany., '81, another one made with the present company, who had bought a large part of the first issue of stock. A second well has been bored by F. Spangler and the system extended as far as the water supply allows. A third well was begun in '88, and it is hoped that the supply from this will be sufficient to permit the laying of the 30 miles of mains originally contracted for.

Water Supply.—Artesian wells, pumping to stand-pipe for domestic supply: water passes to reservoir, and is stored for fire protection.

The well begun in '76 is 1,970 ft. deep, has 5-in. tubing at top, and 2¾ in. at bottom. The water first rose 90 ft. above the surface, had a temperature of 99 degrees Fahrenheit, and the daily yield is about 200,000 galls. The well cost $25,000, and it took a little over a year to sink it. The contract for the second well provided a depth of 2,000 ft., 10 to 6 in. bore, and the price was $30,000.

Pumping Machinery.—Dy. cap., 6,000,000 galls.: two 3,000,000 gall.-Knowles pumps.

Stand-Pipe.—Is 18 ft. in diam., 90 ft. high, and is filled through a 20-in. force main.

Reservoir.—Cap., 3,300,000 galls. A new 10,000,000-gall. reservoir is being built. The old reservoir is in excavation 12 ft., with 8-ft. embankments. The bottom is of shell formation, upon which is 12-in. of puddled clay, then brick laid in gravel, grouted with cement. The wells have 2 ft. of puddle upon which are two courses of brick laid edgewise in cement. The east wall sunk several inches, making a crack at each angle, which was filled with cement. No leak is apparent.

The first well was ¼ mile from the reservoir and discharged into it about 6 . above the surface through a 4-in. pipe.

Distribution.—*Mains*, c. i., steel, 18 miles; 6 miles are of steel. *Services*, galv. i., lead. *Taps*, 900. *Meters*, 20. *Hydrants*, Chapman, Ludlow, about 300. *Valves*, Chapman, Ludlow.

Consumption, 600,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, withheld. Capital stock, "nominal." Bonded debt $400,000, $200,000 at 5%, and $200,000 at 6%. The first issue was $250,000 of 6% bonds, but with the reorganization these were scaled down to $200,000 at 5%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $11,500, being $9,000 for first 12 miles and $333.33 for each additional miles.

Management.—Prest., Andrew Simonds. Secy. and Treas., Zimmerman Davis, Mech. Engr., Jos. P. Chapman.

BEAUFORT, *Beaufort Co.* (Pop., 2,549,) On Port Royal river about 15 miles from the ocean, and has good harbor.

General Description.—The town has five or six artesian wells. No further data given. Supt., J. W. Collins.

OLUMBIA, *Richland Co.* (Pop., 10,036; est., 15,000.) On Congaree river, and is a business and manufacturing center.

History.—Owned by city, date built not given. Engr., D. B. Miller. Extensions made in '88.

Water Supply.—Congaree river, and springs, pumping to reservoir.

Pumping Machinery.—Worthington pump, dy. cap., not given.

Reservoir.—Cap., old, 1,500,000 galls., and new, 5,000,000 galls.

Distribution.—*Mains*, 6 to 12-in., material not given, 16 miles. *Services*, *Taps* and *Meters*, not given. *Hydrants*, kind not given, about 110.

Consumption, 600,000 galls. *Pressure*: 20 to 60 lbs.

Financial.—Cost, debt and int., withheld. Ann. op. exp., $7,000. Ann. rev.: withheld.

Management.—City Council. Supt., Henry Alexander. City Clerk and Treas., Wm. J. Cathcart.

ORANGEBURGH, *Orangeburgh Co.* (Pop., 2,140; est., 4,000.)

History.—Built in '87, the artesian well being owned by Geo. H. Cornelson and the distribution by the town. The system will be extended when the town is able to do so, but at present is used for fire protection, only on one street.

Water Supply.—Artesian well, pumping to stand-pipe.

Pumping Machienry—Dy. cap., not given; one Knowles and one Worthington pump.

Stand-Pipe.—Is 8 ft. in diam. by 74 ft. high.

Distribution.—*Mains*, 6 and 3-in. 1,800 ft. *Hydrants*, Chapman, 24. *Valves*, Chapman.

Pressure: 40 lbs.

Financial.—Cost, not given. No debt. Ann. op. exp., $100. No rev.

Management.—By town. Report by Geo. H. Cornelson.

Water-Works Completed with Fair Prospects of Construction

SENECA, *Oconee Co.* (Pop., 382; est., 800.)

Proposed System.—Pumping water from spring to tank at a cost of about $2,000. No contracts had been let Nov. 12, '88. Address J. W. Stribling.

SPARTANBURGH, *Spartanburgh Co.* (Pop., 3,253.)

Proposed System.—The town has let two contracts for works, but the contractors have done nothing. Works are desired, and the Clerk of the Council, J. M. Elford, thinks a good contract could be made. Address E. H. Burlingame.

Present Supply.—Ten cisterns filled from roofs, for fire protection.

SUMTER, *Sumter Co.* (Pop., 2,011.)

Proposed System.—Two or three propositions to build works were made by private parties in '87-8, but to Nov., '88, nothing definite had been done. The supply will probably be pumped from driven wells, and one plan was for four miles of pipe and 50 hydrants. The cost has been estimated at from $20,000 to $50,000. Address J. A. Wood, Mayor, or C. M. Hurst, Town Clerk.

Present Supply.—Wells and cisterns.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Aiken, *Aiken Co.*; Allendale, *Barnwell Co.*; Winnsborough, *Fairfield Co.*: Yorkville, *York Co.*

Water-Works Completed or in Process of Construction.

GEORGIA.

ATHENS, *Clarke Co.* (Pop., 6,099; est., 10,000.) On Oconee river in hilly country. Does considerable manufacturing. Settled about '10.

History.—Built in '82-3 by Athens City Water-Works Co., under a 30 years' franchise. Des. Engr., David M. Greene, New York City. Const. Engr., Chas. H. Ledlie, St. Louis, Mo. All labor done by the Co.

Water Supply.—Two spring-bed creeks, pumping to stand-pipe. Direct pumping can be used. There are six springs issuing from sandstone.

Impounding Reservoir.—Cap., 23,000,000 galls.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; two Blake pumps of 750,000 and 1,000,000 galls. cap., respectively, one being a compound condensing, and the other a high-pressure, used for fire protection.

Stand-Pipe.—Cap., 366,000 galls.; 18½ ft. in diam. by 100 ft. high; furnished by Cunningham Iron Works, Boston.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. Pipe and specials furnished by the Chattanooga (Tenn.), Foundry & Pipe Works. *Taps*, 250. *Meters*, 8. *Hydrants* Ludlow, 53. *Valves*, Ludlow.

Consumption, 150,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 112 lbs.

Financial.—Cost, $86,000. Bonded debt, $75,000. Int., 5%. Ann. op. exp., $2.300. Ann. rev.: consumers, $5,000; city, $3,180. Hydrant rental, $60.

Management.—Prest., Wm. H. Howell, Box 2640 New York City. Secy., G. M. Church. Supt., W. McKinnon.

ATLANTA, *Fulton Co.* (Pop., 37,409; est., 66,000.) Is 1,100 ft. above the sea. A trade and manufacturing center. Settled in '45 as Marthasville; incorp. a city in '47 under its present name.

History.—Built in '74-5 by city. Des. Engr., A. R. Ketchum. Const. Engr., Jno. A. Grant.

Water Supply.—Direct pumping from impounding dam on headwaters of South river, and pumping to tank from artesien well. The stream has a drainage area of about 12 sq. m. of sandy ground, overlying clay, and containing many springs. The water of the stream is very muddy, but by filtering a good qualtity is secured.

Dam.—Across ravine, and forms reservoir. Of earth, 214 ft. long, 55 ft. high, with puddle heart-wall 20 ft. wide at base, 6 at top, and 59 ft. high. Upper slope, 2 to 1; lower, 1 to 1.

Reservoir.—Cap., 250,000,000 galls.; covers 51·3 acres.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Holly quadruplex pumps and six tubular boilers.

Filtering Plant.—Hyatt, contract cap., 3,000,000 galls. a day. The official test showed a dy. cap. of over 4,000,000. The plant was put in operation, Nov., '87. There is a clear water basin 45 by 95 ft., by 25 ft. deep, two sides and one end being of brick, and the other end of large stone in cement, with a backing of earth all round.

The walls are about 10 ft. thick at the bottom, and 3 at the top. The bottom is covered with cement. The reservoir was partly filled before the earth was packed around the two sides which are in embankment, and these sides gave way. They were successfully repaired.

Tank.—Cap., not given. Erected in '86 in connection with the artesian well supply. Contr., J. W. Baum.

Distribution.--*Mains*, c. i., 27 miles. *Services*, lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky. Trenching and pipe-laying done by Hunnicutt & Billingrath, Atlanta. *Taps*, 2,000. *Meters*, 2,000. The adoption of meters has proved a great saving to the city reducing the pumpage and increasing the pressure. They have worked much better since the filtering plant was put in. Unfortunately the consumers choose their own meter, often putting in a size smaller than the service-pipe. This "runs the meter to death." *Hydrants*, Mathews, Ludlow, Holly, Chapman, Galvin, 342. *Valves*, Morris & Tasker, Galvin, Chapman.

Consumption, (in '86), 1,575,416 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $450,000. Debt, $440,000. Int., 7%. Ann. op. exp., for '86, $17,936. Ann. rev.: for '86, $32,751; city, none.

Management.—Six Commrs. Prest., C. C. Hammock. Secy., G. W. Terry, Jr. Supt., W. G. Richards.

AUGUSTA, *Richmond Co.* (Pop., 21,891; est., 46,000.) On Savannah river at head of navigation, 147 ft. above mean low tide. On a level plain, the soil being composed of alternate layers of sand and clay with coarse sand and pebbles for a depth of 75 ft. Engaged in manufacturing and cotton trade. Laid out by Gen. Oglethorpe in 1735; incorp. a town in 1796, and chartered a city in '18.

History.—Supplied from '28 to '61, by Turknett Springs Water-Works. In '59 to '61 the city built works which were enlarged in '84. Jan. 1, '82, the Turknett Springs system was abandoned. For the works built in '59-61, Alfred W. Craven, New York City, was Des. Engr., his plans being somewhat changed by Const. Engr., Wm. Phillips. The Engr. for work done in '84 was A. H. Davidson, City Engr.

In Mar., '28, the City Council granted the right to furnish the city with water to Thos. McGrew, who built the Turknett Springs Water-Works, taking water by gravity from a spring 2¼ miles southwest of the city. July 15, '29, he conveyed the works to Wm. Hale, then Mayor, who sold them to the city on Mar. 26, '40, for $1,800. The system was then extended.

The pipes were of native pine logs, the supply main being of 6-in., the distributing mains, 6 to 3-in., and the services, 3-in. bore. The latter had an upright end, water being taken through a 2-in. orifice by withdrawing a pine plug. The springs were 43 ft. above the city. After the introduction of the new supply in '61 the consumers of this water gradually fell off, the price being $20 a family or hydrant. In '76 there were 291 takers, in '79, 184 and in '80, 176. The dy. cap. of this source in '77 was 186,256 galls. The disbursements for this system from '40, when bought by city, to Jan. 1, '81, had been $802,702, and the receipts, $101,815.

Water Supply.—Savannah river, through Augusta canal and settling basins, by direct pumping and pumping to tank.

The Augusta canal was built to furnish water-power for manufacturing purposes, and is formed by a dam 7 miles from the city which diverts water to it. It also receives wholesome water from seven streams. The area of the canal at the entrance is 1,462 ft. Its width is 150 ft. at water surface, 106 ft. at bottom, and its depth, 11 ft.

Settling Basins.—Three, adjoining canal, and within city limits. They were made necessary by the large amount of clay in suspension carried by the river water. The first basin receives the water from the canal, is 10 ft. deep, and from it water passes to the second basin, 200 ft. sq. by 15 ft. deep. This was designed to act as a filter, but the war prevented its completion as such, and water simply passes through the ¼-in. joints of the brick paving to the third, or clear water basin. This is 15 ft. deep, and water passes from it through a conduit to the pump-well.

Conduit and Pump-well.—The conduit is 3,445 ft. long, of 20-in. cast-iron pipe. The pump-well is of ¼-in. plate-iron, 9 ft. in diam. and 24 ft. deep. The bottom of the well is 17 ft. below the water surface of the basins.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; one 5,000,000-gall. R. D. Wood & Co. water-power pump, and one 3,000,000-gall. Worthington pump. The two old pumps were made by I. P. Morris & Co., were double-acting plunger pumps, with

18½-in. barrels, 12-in. plungers, and 36-in. stroke, and were operated by a Jonval turbine under 11 ft. head and fall. There has also been a small auxiliary steam engine with double-acting force pump of 20-in. bore and stroke.

Force Mains.—In '81 the pumps delivered to a 16-in. cast-iron main, which at 130 ft. from the air chamber branched north 370 ft. to the tank ,and south 2,360 ft. to Broad and Ninth streets, where four 6-in. mains radiated, supplying the greater part of the city by direct pumping.

Tank.—Of ⅜-in. plate-iron, 37 ft. in diam. and 30 ft. high, with a central core 7 ft. in diam. through which a staircase is carried. The tank is supported by 32 cast-iron girders resting on two annular brick walls, 84 ft. high, founded on 3 ft. of concrete. The outer ring is 39½ ft. in diam.,and 3¾ ft. thick at the bottom,and the inner 12½ ft. in diam. and 2.67 ft. thick at bottom. Both are 18 in. thick at top. The water surface in the tank is 106.32 ft. above the pumps, and 96 ft. above Broad and Ninth streets. In '81 the tank supplied one 6-in. pipe leading south.

Distribution.—*Mains*, c. i., 30 miles. *Services*, galv. i. *Taps*, (in '86.) 1,728. *Meters*, none. *Hydrants*, McClennan, Mathews, Ludlow, Eddy, 248. *Valves*, kind, do.

Consumption 2,755,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 60 lbs.

Financial.—Cost and debt to date not given, as these items are not kept separate from the city finances. Original cost, $200,000. Disbursements to Dec. 31, '81, $361,432; receipts, $131,486. Ann. op. exp., $5,490. Ann. rev.: consumers, $28,843.

Management.—Comm. of four. Chf. Engr., A. H. Davidson. Supt., Wm. Bennett. Inspecter and Collector, E. E. Doscher. Pumping Engr., Dennis Bennett.

BAINBRIDGE, *Decatur Co.* (Pop., 1,436; est., 1,800.) On Flint river.

History.—Built in '82-6 by town. No Engr. employed. The wells were sunk in '82; Contrs., Jno. Pfleffer & Co., Cincinnati. Contr. for masonry, L. F. Patterson; for buildings, J. I. Robinson. Both of Bainbridge.

Water Supply.—Artesian wells, pumping to tank.

Pumping Machinery.—Knowles pump, dy. cap., not given.

Tank.—Is 18 ft. in diam. and 17 ft. high; furnished by King Iron Bridge Co., Cleveland, O.

Distribution.—*Mains*, 5 miles of 6-in. pipe, kind not given. *Services*, ½ and ¾-in., kind not given. *Taps*, 75. *Meters*, none. *Hydrants*, Holyoke, 10.

Consumption, 15,000 galls. *Pressure*: Ordinary, 15 lbs. Fire, 15 lbs.

Financial.—Cost, $15,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $600. Ann. rev.: not given.

Management.—City Council. Report by J. D. Howell.

BRUNSWICK, *Glynn Co.* (Pop., 2,891; est., 6,000.) On inlet of Atlantic ocean, and has good harbor.

History.—Built in '86 by Brunswick Light & Water Co., under a 20 years' franchise. Engr., A. E. Boardman, of Jeter & Boardman, Macon, Ga., the Contrs.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Worthington pump, dy. cap., 750,000 galls.

Tank.—Cap., 112,000 galls.; on a tower.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. w. i. *Taps*, 285. *Meters*, Worthington, 5. *Hydrants*, Mathews, 75. *Valves*, Eddy.

Consumption, 250,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 100 lbs.

Financial.—Cost, $96,000. Capital stock, $50,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., withheld. Ann. rev.; consumers, withheld; city, $3,750. Hydrant rental, $50.

Management.—Prest., W. E. Burbage. Secy., J. B. Hall. Supt. and Treas., A. E. Boardman, Macon.

COLUMBUS, *Muscogee Co.* (Pop., 10,123; est., 30,000.) At head of navigation on Chattahoochee river. Has extensive cotton manufactories. Incorp. a city in '27.

History.—Built in '82 by Columbus Water-Works Co. Engrs., Jacob H. Yocum and T. R. White. Work done by Co.

Water Supply.—Headwaters of Holland's creek, in Alabama, by gravity from impounding reservoirs to stand-pipe. The creek has a drainage area of 12 sq. m., and a dy. cap. of 15,000,000 galls., after allowing one-half the rainfall for absorption and evaporation.

Dams.—The two reservoirs are near together and are formed by stone dams across a ravine. The lower dam is 250 ft. long. This dam was of stone, blasted from the reservoir, and laid in cement mortar

The lower dam was 266 ft. long, 21 ft. high, with an overflow 100 ft. long, and abutments and slope walls at each end, and 4 and 6-ft. dyke-walls running from these each way to fast land. All these walls were of stone in hydraulic mortar. On both sides of the dyke-walls were clay and gravel embankments placed in layers of about 4-in. tamped, the clay being next the wall. The inner slope was paved with spalls from the reservoir, and the outer covered with black earth and Bermuda grass.

Reservoir.—Cap., 120,000 galls.; one with a cap. of 20,000,000 galls., 115½ ft. above the centre of the city and the other with a cap. of 100,000,000 galls., 130½ ft. above the city. The second reservoir was finished in '84. The land flooded by the reservoir was originally covered with timber and cane. All the stumps and roots were grubbed out and the muck removed.

Filter.—On inside of reservoir, 16 ft. sq.,packed with charcoal.

Conduit.—Of 12 in. cast-iron pipe, 18,009 ft. long, crossing the Chattahoochee river by two 9-in. wrought-iron pipes, 900 ft long, laid beneath the floor girders of one of the city bridges.

Stand-Pipe.-Steel,20 ft. in diam. and 120 ft. high;furnished by Union Iron Works, Chattanooga, Tenn.

Distribution.—*Mains*, c. i., 14 miles. *Services*, galv. w. i. *Taps*, 800. *Meters*, 40. *Hydrants*, Cassin, 85.

Consumption, not given. *Pressure*: 36 to 50 lbs.

Financial.—Cost, $200,000. Capital stock, in '84, $150,000. Bonded debt, withheld. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $6,800. Hydrant rental, $80.

Management.—Prest., B. F. Archer. Secy and Treas., Geo. Bailey. Supt., M. H. Taggle.

DALTON, *Whitfield Co.* (Pop., 2,516; est., 3,500.) In agricultural region.

History.—Built in '88 by town. Engr., L. J. Wagner, Rome. Contrs., Union Iron Works, Chattanooga, Tenn.

Water Supply.—Spring, pumping to stand-pipe from settling reservoir.

Settling Reservoir.—Cap., 188,000 galls.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000-gall. compound duplex Gordon & Maxwell pumps.

Stand-Pipe.—Cap., 115,000 galls., of steel.

Distribution.—*Mains*, c. i., 5¼ miles. *Services*, w. i. *Taps*, 116. *Meters*, none. *Hydrants*, Cincinnati, 38 public and 4 private. *Valves*, Scott.

Consumption, not determined. *Pressure*; Ordinary, 70 lbs.

Financial.—Cost,about $30,000. Bonded debt,$30,000; bonds run for 30 years. Int., 5%, payable semi-annually. Ann. op. exp. and rev., not determined.

Management.—C. G. Spencer. Report by J. R. McAfee.

FORT GAINES, *Clay Co.* (Pop., 867; est., 2,000.) On Chattahoochee river.

History.—Built in '77-8 by town. Engr. and Contr., J. W. Baum, Atlanta.

Water Supply.—Artesian well, 4 in. in diam., pumping to tank.

Pumping Machinery.—Deane pump, dy. cap., 216,000 galls.

Tank.—Cap., 21,000 galls.

Distribution.—*Mains*, 4-in. black i., 2,000 ft. *Hydrants*, P. White, 16.

Consumption, 12,000. *Pressure*: 70 lbs.

Financial.—Cost, $2,000. Debt, not given. Ann. op. exp., $600. Ann. rev.: not given.

Management.—Mayor, S. D. Coleman.

MACON, *Bibb Co.* (Pop., 12,749; est., 28,000.) On Ocmulgee river. The business portion is on level ground between the river swamp and a range of hills. Most of the residences are on the hills. Has large cotton and other trade. Settled in '22; incorp. a town in '23 and a city in '32.

History.—Built in '81 by Macon Gas Light & Water Co. Engr., A. E. Boardman. Work done by the Co.

Water Supply.—Springs, pumping to reservoir and to tank. The springs are two miles from center of city, and water is conveyed from them to a pump-well near by.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound duplex Worthington pumps, and three return tubular boilers, of 175 H. P.

Force Main.—To reservoir; 7,780 ft. of 12-in. cast-iron pipe with 150 ft. rise.

Reservoir.—Cap., 2,500,000 galls.; 100 by 220 ft., by 26 ft. deep; on side hill, in excavation and embankment, puddled and lined with 6-in. of concrete. The water-surface is 127 ft. above the city.

Tank.—Cap., 75,000 galls.

Distribution.—*Mains*, c. i., 23.5 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,015. *Meters*, 248. *Hydrants*, Mathews, 200. *Valves*, Eddy.

Consumption, 1,150,000 galls. *Pressure*, 50 lbs.

Financial.—Cost, $215,000. Capital stock, $150,000. Bonded debt, $115,000. Int., 6%. Ann. op. exp., $9,850. Ann. rev.: consumers, $21,000; city, $8,600. Hydrant rental, $40.

Management.—Prest., J. M. Boardman. Secy., J. B. Hall. Supt., A. E. Boardman. Asst. Supt., J. W. Wilcox.

ROME, *Floyd Co.* (Pop., 3,877; est., 10,000.) On Coosa river, in an agricultural section, and is center of trade.

History.—Built in '71 by city. Contrs., Noble Bros. & Co.

Water Supply.—Wells, pumping to stand-pipe. The first well was 12 ft. in diam., 50 ft. deep, with a tunnel extending 30 ft. each way from the bottom. Two 12-in. wells were sunk in '87, one being 96, and the other 116 ft. deep.

Pumping Machinery.—Dy. cap., 2,750,000 galls. The first pump had a cap. of 700,000 galls., and was a beam engine with 20-in. steam and 16-in. water cylinder, of 42-in. stroke.

Stand-Pipe.—Wrought-iron, 25 ft. in diam. and 63 ft. high, placed on a hill in the center of city. Flow line is 200 ft. above water in first well.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 500. *Meters*, 43. *Hydrants*, Mathews, 83. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure*: Ordinary, 77 lbs. Fire, 77 lbs.

Financial.—Cost, $96,000. Debt, $80 000. Int., 6%. Ann. op. exp., $3,700. Ann. rev.: consumers, $7,000; city, none.

Management.—Supt., L. J. Wagner.

SAVANNAH, *Chatham Co.* (Pop., 30,709; est., 52,000.) On right bank of Savannah river, 18 miles from its mouth, on a sandy plain 40 ft. above the river, with one narrow street below the steep bluff. Engaged in foreign and domestic commerce, handling large amounts of cotton, rice, rosin, and turpentine. Settled in 1733.

History.—Built in '53-4 by city. Engr., Henry R. Worthington. Contr. for masonry, C. C. Casey; for buildings, C. Vanhorne.

Water Supply.—Since '87, artesian wells, by direct pumping; prior to this, Savannah river, pumping to settling basins for low, and to tank for high service. The latter source can still be used in case of necessity.

There are two 10-in., 12 6-in., and one 4-in. wells.

Old Supply.—*Four settling basins*, each of 1,000,000 cap., having their bottoms covered with concrete and their sides paved with brick, and being 130 ft. above the pumps.

The tank is of wrought iron, 30 ft. in diam., and 36 ft. high, placed on a brick tower, 80 ft. high. As stated above, the old supply is not used at present, but it is kept in order for immediate service.

Pumping Machinery.—Dy. cap., 12,500,000 galls.; one 7,500,000 galls. and one 5,000,000-gall. Worthington pump.

Distribution.—*Mains*, c. i., 32.6 miles. *Services*, lead, w. i. Pipe and specials furnished by R. D. Wood & Co., and the Gloucester Iron Works, Philadelphia, Pa. Trenching and pipe-laying done by city. *Taps*, 2,850. *Meters*, none. *Hydrants*, Chapman, 312.

Consumption, 5,715,000 galls. *Pressure*, 30 lbs.

Financial.—Cost, to '82, $300,000. Debt, to '82, $198,000. Int., 5%. Ann. op. exp., $13,295. Ann. rev.: consumers, $49,174; city, none.

Management.—City Council. Supt. and Engr., Alvin N. Miller. Inspector, Jos. C. Cornell. Pumping Engrs., Wm. W. Metzer and James Holland.

THOMASVILLE, *Thomas Co.* (Pop., 2,555; est., 4,500.) In cotton, and sugar-cane region. Also a summer resort.

History.—Put in operation July, '88, by town. Contrs., Union Iron Works, Chattanooga, Tenn.

Water Supply.—Two artesian wells, pumping to tank.

Pumping Machinery.—Gordon & Maxwell pump; dy. cap., 288,000 galls.

Tank.—Wrought iron, 25 ft. in diam. and 30 ft. high, placed on a brick tower 70 ft. high. Dec. 6, '87, the tower collapsed before completion, killing four men. A brick pier 6 ft. in diam. was being carried up in the center, and a circular brick wall outside. The scaffolding between the two was removed before the tower was completed, and the pier fell, carrying with it the outer wall.

Distribution.—Pipe, specials, valves and hydrants furnished by R. D. Wood & Co. Philadelphia, Pa.

Financial.—Cost, about $20,000. Debt, $15,000. Int., 5%.

Management.—Clerk, K. T. Machon.

NOTE.—These works were not finished at time of report, hence its incompleteness.

Water-Works Projected with Fair Prospects of Construction.

HINESVILLE, *Liberty Co.* (Pop., est., 500.) In timber, cotton and rice regions of East Georgia.

Proposed System.—The Hinesville Water-Works Co. propose to supply the town from a mineral spring 1,500 from center of village, pumping by water-power to reservoir 10 ft. higher than spring. The spring has a flow of 700 galls. an hour. Prest. of Co., O. C. Smith. Report ba J. M. Dorsey.

Present Supply.—Driven wells.

LA GRANGE, *Troup Co.* (Pop., 2,295; est., 2,500.) Manufactures cotton-seed oil, guano and carriages.

Proposed System.—An effort to build works has been made. Address H. E. Ware, Mayor, or F. M. Ridley.

MARIETTA, *Cobb Co.* (Pop., 2,227; est., 3,500.) Winter resort, 20 miles from Atlanta.

Proposed System.—Several attempts to build works have recently been made, the latest one reported being by Jeter & Boardman, Macon. The town was to vote on issuing bonds for water-works and electric light, Nov. 14. Address Geo. S. Owen.

Present Supply.—Seven cisterns, filled from roofs of buildings and pumps.

MILLEDGEVILLE, *Baldwin Co.* (Pop., 3,800,; est., 5,000.) On Oconee river in an agricultural district. Has water-power.

Proposed System.—The Milledgeville Water Co. propose to supply the town from springs, by gravity to and from reservoir. Cost, $30,000. June 9, '88, the capital had been nearly all secured, but the Co. had not been organized. The matter was to be settled July 8; Nov. 14 the project had not been abandoned. Address Sam Walker, Mayor, or City Clerk, G. W. Caraker.

Present Supply.—Six cisterns supplied from house-roofs. Cap., 20,000 galls.

VALDOSTA, *Lowndes Co.* (Pop., 1,515; est., 2,000.) In agricultural region.

Proposed System.—Nothing definite decided in July, '88, but works had been proposed. City Clerk, O. M. Smith.

WASHINGTON, *Wilkes Co.* (Pop., 2,199; est., 3,000.) In cotton and grain section, about 70 miles from Atlanta.

Proposed System.—A bill to authorize the issue of $10,000 of bonds for the construction of water-works was before the Legislature, Nov. 17, '88. It was thought that it would pass. If so, water will be pumped from a spring to a stand-pipe. Wm. A. Benson or T. C. Hogue can give information, or T. Burnwell Green, who made report.

WAY CROSS, *Ware Co.* (Pop., 1,440; est., 1,500.) Manufactures lumber and handles naval stores.

Proposed System.—Estimates were being made in Oct., '88. Pumping wil probably be used. Address E. H. Crawley, or J. L. Sweat.

Water-Works Projects Reported in '87-8, but Now Indefinite.

Acworth, *Cobb Co.*; Carrollton, *Carrol Co.*; Crawford, *Oglethorpe Co.*; Davisboro, *Washington Co.*; Gainesville, *Hall' Co.*; Griffin, *Spaulding Co.*; Riddleville *Washington Co.*; Sandersville *Jefferson Co.*; Wadley, *Washington Co.*

Water-Works Completed or in Process of Construction.

FLORIDA.

DE LAND, *Volusia Co.* (Pop., est., 2,400.) On St. John's river, in agricultural and fruit-raising section.

General Description.—In '86 a contract for water-works was made with A. A. Parker, but never fulfilled. In '87 a contract was let for an artesian well, which in Nov., '88, had been sunk 465 ft., through rock, and yielded water within pumping distance of the surface. Owing to yellow fever in the fall of '88 all work was abandoned until Jan., '89, when it was intended to complete the system. The city will issue $30,000 of bonds to pay for the works. City Clerk, Silas B. Wright.

FERNANDINA, *Nassau Co.* (Pop., 2,562; est., 4,000.) On Amelia island and Amelia river, 33 miles from Jacksonville. Has good harbor and considerable trade.

General Description.—An 8-in. artesian well has been sunk, and proposals for a system of water-works were to be opened Aug. 1, '88. Pumping will be used. Chairman Board of Public Works, Geo. R. Fairbanks.

JACKSONVILLE, *Duval Co.* (Pop., 7,650; est., 25,000.) On west bank of St. John's river, 25 miles from its mouth, at an elevation from 5 to 33 ft. above tidewater. A winter resort, also engaged in lumber and other trade. Incorp. in '57.

History.—Built in '79-80 by city. Engr., R. N. Ellis.

Water Supply.—Artesian wells, by direct pumping. Three: one 3 in. in diam. and 490 ft. deep; one 6 in. in diam. and 635 ft. deep, one 650 ft. deep. The daily flow of the wells is 2,419,000 galls. Water was first pumped from a well 50 ft. in diam. and 31 ft. deep with walls of brick in Portland cement. For the first 20 ft. the well was through sand, then through 11 ft. of rock. This well yielded 1,200,000 galls. a day and was covered with a slate roof.

Pumping Machinery.—Dy. Cap., 4,500,000 galls.; one 3,000,000, and one 1,500,000-gall. compound duplex Worthington pump.

Stand Pipe.—*Not in use.* Water for domestic consumption was formerly pumped to this.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, Enam. I. *Taps*, 707. *Meters*, 287. *Hydrants*, Coffin, Ludlow, 100.

Consumption, 918,305 galls. *Pressure*: Ordinary, 45 lbs. Fire, 110 lbs.

Financial.—Cost, $112,000. Debt, $100,000. Int., 8%. Ann. op. exp., about $9,200. Ann. rev.: consumers, $16,521; city, none.

Management.—Trustees of Sanitary Improvement Bonds. Supt., R. N. Ellis. Pumping Engr., E. J. Howard.

LAKE CITY, *Columbia Co.* (Pop., 1,379; est., 2,000.) Center of Sea Island cotton region.

History.—Built in '87-8 by Lake City Water & Light Co. Engr., Noyes S. Collins.

Water Supply.—Lake Isabella, pumping to tank.

Pumping Machinery.—Dy. cap., not given; one 5-in. compound, and one 4-in. Worthington pump, the latter for reserve.

Tank.—Cap., 16,000 galls.: 60 ft. high.

Distribution.—*Mains*, 4 and 6-in., kind not given, 1.2 miles. *Hydrants*, 30.

Financial.—Cost, $15,000.

Management.—Prest., Noyes S. Collins. Report by A. B. Hart.

NOTE:—Works were not finished at time of report.

OCALA, *Marion Co.* (Pop., 803; est., 2,700.) In agricultural section.

History.—Built in '87-8 by Ocala Water Co., under 25 years' franchise. Engr. A. E. Boardman, of Jeter & Boardman, Macon, Ga., who were Contrs.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Cap., 800,000 galls.; duplex high-pressure Worthington pump.

Tank.—Is 25 by 30 ft., on brick masonry tower, 40 ft. high. Furnished by R. D. Wood & Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 94. *Meters*, not given. *Hydrants*, Mathews, 60. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, $73,000, Capital stock, $50,000. Bonded debt, $35,000. Int., 7%. Ann. op. exp., not determined, Ann. rev.: consumers, not determined; city, $3,000. Hydrant rental, $50.

Management.—Prest., A. D. Schofield. Secy., R. L. Anderson. Treas., A. E. Boardman, Macon, Ga. Supt., J. H. Campbell.

ORLANDO, *Orange Co.* (Pop., est., 6,000.)

History.—Built in '87 by Orlando Water Co. Engr., J. Dittman, Williamsport, Pa. Contr. for masonry and buildings, Geo. LeMoyne.

Water Supply.—Highland Lake, direct pumping, and pumping to stand-pipe.

Pumping Machinery.—Knowles duplex pump, dy. cap., 1,000,000 galls. Two return tubular boilers, of steel, furnished by E. Keeler & Co., Williamsport, Pa.

Stand-Pipe.—Is 12 ft. in diam., and 125 ft. high; furnished by E. Keeler & Co., Williamsport, Pa.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe furnished by Jno. J. Fisher, Allentown, Pa. *Taps*, 140. *Meters*, none. *Hydrants*, Bailey, 50. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 160 lbs.

Financial.—Cost, $150,000. Capital stock, $50,000. Bonded debt, $100,000. Int., not given. Ann. op. exp., $3,000. Ann. rev.: consumers, $2,000; city, $3,000. Hydrant rental, $60 for 50, and $50 for additional.

Management.—Prest., Geo. Lentz. Treas., H. Hinckley. Secy., A. Johnson. Local Mgr., H. W. Gretham.

PALATKA, *Putnam Co.* (Pop., 1,616; est., 5,000.) On St. Johns river in an agricultural region.

History.—Built in '86-7 by Palatka Water-Works Co., under a 20 years' franchise. Engrs. and Contrs., Wheeler & Parks, Boston. The Co. put in masonry and erected buildings.

Water Supply.—White Water branch, fed by a spring, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; one compound and one single Worthington pump, and two tubular boilers.

Stand-Pipe.—Is 25 ft. in diam. and 100 ft. high; furnished by E. Hodge & Co. South Boston, Mass.

Distribution.—*Mains*, c. i., 6 miles. *Services*, enam. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 130. *Meters*, 4. *Hydrants*, Coffin, 65. *Valves*, Coffin.

Consumption, 75,000 galls. *Pressure*: 60 to 90 lbs.

Financial.—Cost, $65,000. Capital stock, $65,000. Bonded debt, $65,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,000; city, $2,500. Hydrant rental, $50.

Management.—Prest., Harvey Wheeler. V. Prest., Chas. Underwood. Treas., Elbert Wheeler. Supt., J. H. Yeaton.

PENSACOLA, *Escambia Co.* (Pop., 6,845; est., 15,000.) On Pensacola bay 6 miles from the Gulf of Mexico. Has fine harbor, and is engaged in lumber and other trade.

History.—Built in '85-6 by Pensacola Water Co., under 50 years' franchise. Engr., C. Delafield, New York City. Contrs., Saml. R. Bullock & Co., New York City.

Water Supply.—Artesian wells, pumping to stand-pipe. The wells are unofficially reported to be 5 in. in diam., and from 175 to 400 ft. deep.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two compound condensing Deane pumps.

Stand-Pipe.—Is ~~2~~ 20 ft. in diam., ~~125~~ 135 ft. high, on a natural elevation; furnished by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 412. *Meters*, 6. *Hydrants*, Pattee & Draper, 100. *Valves*, Pattee & Draper.

Consumption, 50,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $180,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,780. Ann. rev.: consumers, $7,400; city, $6,000. Hydrant rental, $60.

Management.—Prest., B. B. Pitt. Supt., Secy. and Treas., Ed. Gale Quinn.

ST. AUGUSTINE, *St. Johns Co.* (Pop., 2,293; est., 3,500.) On Bay of St. Augustine. A summer resort. One of the oldest towns in the United States, a fort having been built here by the Spaniards in 1565.

General Description.—Four artesian wells, 6 and 3-in. mains, and 35 hydrants. For further particulars address E. F. Joyce, Wellsville, N. Y.

SANFORD, *Orange Co.* (Pop., 1,300; est., 3,500.) On St. John's river on slightly rolling ground. Settled in '71; incorp. a city in '76.

History.—Built in '83 by Sanford Water-Works Co., under a 50 years' franchise. Des. Engr., Terrell & Muckle. Const. Engr., Wm. Beardsall, the present Supt.

Water Supply.—Island lake, by gravity to reservoir, thence by pumping to tanks. Direct pumping can be used in case of fire. The lake is fed by springs, and has an area of 40 acres.

Reservoir.—Cap., 250,000 galls.

Pumping Machinery.—Worthington pump, dy. cap., 1,000,000 galls. Boiler made by Wm. Bates & Son, Conshohocken. Pa.

Tanks.—Cap., 40,000 galls.; two wooden tanks 18 ft. in diam. and 12 ft. high, placed on timber trestles 40 ft. high.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, enam. i. Pipe and specials fur-by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 275. *Meters*, 9. *Hydrants*, made at Orlando Foundry, 30. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure*: Ordinary, 37 lbs. Fire, 100 lbs.

Financial.—Cost, $50,000. Capital stock, $40,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $3,200; city, $1,500. Hydrant rental, $50.

Management.—Prest., H. S. Sanford. V. Prest., F. H. Rand. Supt. and Secy., W. Beardsall.

SEVILLE, *Volusia Co.* (Pop., est., 500.) In timber and orange country.

History.—Built in '86 by the Seville Co., which was incorp. July 15, '85, for the general purpose of dealing in and improving lands, lots and town sites. The water-works and sewerage systems are operated together. Engr., Jas. J. Powers, Brooklyn. All work done by Co

Water Supply.—Lake Louise, pumping to tanks. The lake has a hard sandy bottom, is fed by subterranean springs, and is ½ by 2½ miles.

Pumping Machinery.—Deane duplex pump, dy. cap. 200,000 galls.

Tanks.—Cap., 53 000 galls.; two, on a trestle, 50 ft. high.

Distribution.—*Mains*, 4 to 10-in., kind not given, 1½ miles. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 8.

Consumption, not given. *Pressure*: by gravity from tanks 22 lbs.; pumping through tanks, 45 to 60 lbs.; direct pumping, 180 lbs.

Financial.—Capital stock of the Co., $50,000. No bonds. Ann. op. exp., and rev.: not given.

Management.—Prest., Mason Young, 35 Wall street, New York City. Secy. and Treas., R. H. Mason, Seville.

TAMPA, *Hillsborough Co.* (Pop., 720; est., 3,000.) On Tampa bay with good harbor. Has cigar manufactories.

History.—Built in '88 by Tampa Water-Works Co., under a 30 years franchise. Engr., A. E. Boardman, of Jeter & Boardman Gas & Water Assoc., Macon Ga., who were Contrs.

Water Supply.—Artesian well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls; two duplex high-pressure Worthington pumps.

Tank.—Is 30 by 21 ft., placed on a tower 100 ft. high. Tank furnished by R. D. Wood & Co., Philadelphia, Pa.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Hydrants*, Mathews, 110. *Valves*, Eddy.

Pressure: Ordinary, 50 lbs.

Financial.—Cost, est., $160,000. Capital stock, $100,000. Bonded debt, $82,000. Int., 6%. Ann. rev.: city, $2,210.

Management.—Prest., J. S. Schofield. Secy., W. J. Allen. Treas., A. E. Boardman, Macon, Ga. Supt., J. S. Wynne.

Water-Works Projected with Fair Prospects of Construction.

GAINESVILLE, *Alachua Co.* (Pop., est., 4,000.)

Proposed System.—Various parties have proposed to put in works, among them S. H. Yeaton, Palatka, but the town wish 50 hydrants, *free*, for franchise. Address B. C. Drake, or Town Clerk, W. H. Campbell.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Bartow, *Polk Co.*; Crescent City, *Putnam Co.*; Daytonia, *Brevard Co.*; De Leon Springs, *Volusia Co.*; Eustis, *Lake Co.*; Green Cove Springs, *Clay Co.*; Key West, *Monroe Co.*; Madison, *Madison Co.*; Osceola, *Alachua Co.*; Titusville, *Polk Co.*

GROUP 4.-Gulf and Mississippi Valley States.--Water-Works Completed, in Process of Construction or Projected, in Alabama, Mississippi, Louisiana, Tennessee and Kentucky.

ALABAMA.

Water-Works Completed or in Process of Construction.

ANNISTON, *Calhoun Co.* (Pop., 942; est., 10,000.) On Snow's creek, on rolling land in a valley, and is in coal and iron region. Engaged in iron and other manufacturing. Settled in '72; and incorp. a town '79.

History.—Built in '80-1 by Woodstock Iron Co., and now owned by Anniston City Land Co. Contrs., Noble Bros. & Co., Anniston.

Water Supply.—Artesian well, pumping to stand-pipe. Water was first taken from a well 10 ft in diam. and 60 ft. deep, cased with cast-iron made in segments and settled as the well was sunk. The ground at the top of the well was 50 ft. below the lowest part of the town, and 220 ft. below the top of the tank,

Pumping Machinery.—Dy. cap., 500,000 galls.; one pump of 16-in. bore and 48-in' stroke, driven by a beam engine made by Noble Bros. & Co., Anniston, and one duplex direct-acting Deane pump. It is unofficially reported that a new pump is to be added at once.

Tank.—Of plate-iron, 40 ft. in diam. by 40 ft. high, placed on a stone foundation.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 200. *Meters*, 12. *Hydrants*, kind not given, 56.

Consumption, 35,000 galls. *Pressure*: 90 to 97 lbs.

Financial.—Cost, originally, $50,000. Cost to date and debt not given. No bonds. Ann op. exp., withheld. Ann. rev.: consumers, about $5,000; city, $1,500.

Management.—Prest., Jno. M. McKlerog. V. Prest., Saml. Noble. Treas., D. T. Parker. Supt., H. B. Rudisill. Pumping Engr., J. H. Hathorn.

AUTAUGAVILLE, *Autauga Co.* (Pop., 2,385.)

General Description.—Built in '87-8 by Smith & Muir. Water is taken from a spring about one mile from town. No further data given. Address Morgan M. Smith.

BESSEMER, *Jefferson Co.* (Pop., est., 3,500.) A new manufacturing town 12 miles from Birmingham, between the two largest coking coal fields of the district, close by iron ore deposits, and on limestone formation. Has blast furnace, rolling mill, and other manufactories.

History.—Built in '87-8 by Bessemer Land & Improvement Co. Des. Engr., B. B. Gordon. Contrs., Scovel & Irwin, Nashville, Tenn.

Water Supply.—Two small spring-fed streams, by gravity to pump-pond, thence by pumping to stand-pipe. The streams have an estimated minimum daily flow of 2,000,000 galls.

Reservoirs.—Cap., 8,000,000 galls.; formed by dams, one holding 5,000,000 and the other 3.000,000 galls.

Pump-Pond.—Is 100 ft. in diam. and 6 ft. deep.

Pumping Machinery.—Dy. cap., 2.000,000 galls.; two 1,000,000-gall. Blake duplex pump, and two 45 H. P. Babcock & Wilcox boilers.

Stand Pipe.—Cap., 235,000 galls.; of steel, 20 ft. in diam. and 100 ft. high, and is on an elevation.

Supply Main.—From stand-pipe to town, about one mile of 12-in. cast-iron.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. Pipe and specials furnished by South Pittsburgh (Tenn.) Pipe Works. *Taps*, 75. *Meters*, none. *Hydrants*, from Bourbon Copper & Brass Works, Cincinnatti, O., 45. *Valves*, kind, do.

Consumption, 1,200,000 galls., a large proportion being taken by the manufactories. *Pressure*: Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $95,000. Debt and int., not given. Ann. op. exp., $5,000. Ann. rev.: consumers, withheld; city, none.

Management.—Prest., Wm. Berney. Secy., H. M. McNutt. Genl. Agt. for Co., Geo. M. Wells.

BIRMINGHAM, *Jefferson Co.* (Pop., 3,086; est., 42,000.) In coal and iron region, and engaged in manufacturing.

History.—Built in '72-3, by the Elyton Land Co.; extended since, and now owned by Birmingham Water-Works Co. Engr. of original works, Travers Daniel; Des. Engr. of improvements, W. S. Milner. Const. Engr., J. S. Walker.

Water Supply.—Five mile creek through a canal 7 miles long to settling basin, thence by pumping to reservoir.

It is unofficially reported that in the latter part of '88 contracts were let to Dunn Bros., Columbus, Miss., for a 400 and a 2,300-ft. tunnel, a reservoir with an area of 30 acres, and a canal 6 miles long. It is also stated that the new supply is Cahaba river, and that the Co. will purchase pipe and pumping machinery.

The first supply was from Village creek, with a drainage area of 30 to 40 sq. m, of limestone formation, and a daily flow at low water of about 35,000 galls.

Canal.—Is 7 miles long.

Settling Basin.—Not described.

Pumping Machinery.—Dy. cap., 9,500,000 galls.; three compound duplex pumps, one 6,000,000-gall. Deane, and the other two Blake. The first pump was a 750,000-gall. Worthington, lifting water 150 ft.

Reservoir.—Cap., 4,000,000 galls. The first distributing reservoir had a cap. of 1,000,000 galls., was in excavation and embankment, lined with brick in cement, had round corners, and slopes of 1½ to 1. It was 95½ by 150½ ft. at top, 68 by 113 ft. at bottom, and 12½ ft. deep. To '81 it had leaked badly from time to time.

Distribution.—*Mains*, c. i., 30 miles. *Services*, w. i. *Taps*, 2,000. *Meters*, 200. *Hydrants*, Ludlow, Williams, 57. *Valves*, Ludlow, Chapman, Eddy.,

Consumption, 3 800,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $600,000. Debt, $100,000. Int., 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, $60,000; city, $2,400.

Management.—H. M. Caldwell. Supt., Secy. and Treas., W. J. Milner.

DECATUR, *Morgan Co.* (Pop., 1,063; est., 10,000.) On Tennessee river, in iron region, and has iron and other manufactories.

History.—Built in '87-8 by Decatur Water Co., under a 20 years' franchise. Engrs. and Contrs., Howland & Ellis, Boston, Mass.

Water Supply.—Tennessee river, pumping to stand-pipe, or direct, at will.

Intake Pipe.—Laid by Thacher & Breyman, Toledo, O.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; horizontal duplex condensing high-pressure Deane pump.

Stand-Pipe.—Cap., 270,000 galls.; is 20 ft. in diam. and 120 ft. high, and was made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., about 40 miles. *Services*, w. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps* and *Meters*, not determined. *Hydrants*, Chapman, 380. *Valves*, Chapman.

Consumption, not determined. *Pressure*: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $600,000. Capital stock, $350,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp. and rev. from consumers, not determined. Hydrant rental, $50 for first 100, $40 for second, and $30 for additional.

Management.—Prest., Jno. D. Roquemon. Secy., W. F. Ellis, Jr. Treas., C. C. Harris. Genl. Mgr., A. H. Howland, Boston, Mass.

EUFAULA, *Barbour Co.* (Pop., 3,836; est., 5,000.) On Chattahoochee river.

History.—Built in '87-8 by Eufaula Water Co., under a 20 years' franchise. Engrs. and Contrs., Howland & Ellis, Boston, with Geo. A. Ellis, in charge.

Water Supply.—Little Chewalla creek and Shorter Springs branch, pumping from storage reservoir to stand-pipe. The daily flow of the streams in dry weather is 1,000,000 galls.

Filter.—Is 20 ft. sq., water passing through about 2 ft. of sand and gravel to the storage reservoir.

Reservoir.—Cap., 570,000 galls.; is 64 by 159 ft. and 11 ft. deep. A 10-*in. conduit* leads to the pump-well.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two single plunger Davidson pumps, 10 by 20-in. cylinders and 10-in. plungers, with engines which can be worked as condensing or non-condensing. Two 90 H. P. tubular boilers, 5 by 16 ft.

Stand-Pipe.—Cap., 278,600 galls.; is 26 ft. in diam. and 70 ft. high, between pumps and town, with its top 143 ft. above business part of the city.

Distribution.—*Mains*, c. i., w. i. and cement, 4 to 10 in., 6½ miles. *Services*, w. i. *Taps* and *Meters*, not given. *Hydrants*, Coffin, 50. *Valves*, Coffin.

Consumption, 150,000 galls. *Pressure*: Ordinary, 75 lbs.

Financial.—Cost, $60,000. Capital stock and bonds, $60,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, not determined; city, $3,000. Hydrant rental, $60.

Management.—Prest., S. H. Dent. Secy. and Treas., E. B. Young. Supt., R. H. Walker.

FLORENCE, *Lauderdale Co.* (Pop., est., 4,000.) On Tennessee river at head of navigation.

History.—Built in '87 by Cypress Water-Works Co., under a 20 years' franchise. Des. Engr., Chas. Boech, Atlanta, Ga. Const. Engr. and Contr., Wm. H. Brundige, Florence, Ala. Sub-Contr. for masonry, Mills & Storey; for buildings, J. W. Nichols & Co. Both of Florence.

Water Supply.—Cypress creek, pumping to reservoir.

Pumping Machinery.—Blake duplex pump, dy. cap., 200,000 galls.; upright steel boiler.

Reservoir.—Is 30 ft. in diam. and 18 ft. deep; Contrs., J. W. Nichols & Co., Florence.

Distribution.—*Mains*, 4 and 6-in. c. i., 2½ miles. *Services*, w. i. Pipe and specials furnished by South Pittsburgh (Tenn.) Pipe works. *Taps*, 30. *Meters*, none. *Hydrants*, Ludlow, 6. *Valves*, Ludlow.

Consumption, 4,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 35 lbs.

Financial.—Cost, $10,000. Capital stock, $10,000. No debt. Ann. op. exp., $300. Ann. rev.: consumers, $300; city, $300. Hydrant rental, $50.

Management.—Prest., A. Brown. Secy., J. B. White. Supt., W. H. Brundige.

GADSDEN, *Etawah Co.* (Pop., 1,697; est., 5,000.) On Coosa river, in iron and coal, cotton and grain region. Has manufactories.

History.—Built in '85-6 by Gadsden Water-Works Co., under a 20 years' franchise. Engr., S. H. Lockett, New York City.

Water Supply.—Coosa river, pumping through filter to reservoir.

Pumping Machinery.—Deane pump; dy. cap., 1,000,000 galls.

Filter.—Hyatt, dy. cap., 3,000,000 galls.

Reservoir.—Cap., 1,800,000 galls. Unofficially reported as 128 by 190 ft. at top, 38 by 98 ft. at bottom. 18 ft. deep, 2,000 ft. from and 200 ft. above pumps, and 137 ft. above town.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $62,000. Capital stock, $13,000. Bonded debt, $62,000. Int., 8%. Ann. op. exp., $1,500. Ann. rev.: consumers, $2,100; city, $3,750. Hydrant rental, $75.

Management.—Officers; A. L. Glenn, W. G. Brockway, R. B. Kyle. Supt., M. E. Jones.

HUNTSVILLE, *Madison Co.* (Pop., 4,977; est., 7,000.) On western foot hills of Cumberland mountains. Has various manufactories. Settled about '13.

History.—Built in '25, and now owned by city. In '25, bored logs were laid from a large spring to the public square, 400 ft. The spring issues from a limestone bluff 40 ft. high, and is on land then owned by Dr. Thomas Fearn, who, in '36, agreed with the City Council to build jointly with them a reservoir above the spring. The Doctor put in a turbine wheel and pump, laid pipes, and collected water rents. In '58 the town purchased the works and springs for $10,000.

Water Supply.—Spring, with daily flow of 2,000,000 galls, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Gordon & Maxwell compound condensing pump. The first pump was driven by a turbine. In '69 a Worthington pump was added to supplement the water-power pump, and both have since been replaced by the above.

Reservoir.—Cap., 200,000 galls.; is 60 ft. in diam., and 80 ft. above spring.

Distribution.—*Mains*, 12 to 4-in. c. i., 9 miles. *Services*, w. i. *Taps*, (in '83,) 200. *Meters*, not given. *Hydrants*, kind not given, about 40.

Consumption, (in '82,) 450,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., $2,800. Ann. rev.: consumers, (in '82,) $2,110.

Management.—Supt., B. W. Blake.

JACKSONVILLE, *Calhoun Co.* (Pop., 882; est., 2,000.) A summer resort in an agricultural region.

History.—Built in '83 by town. Engr., Jno. H. Farney.

Water Supply.—Springs on mountain, by gravity to and from reservoir.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 4 in., kind not given, 4 miles. *Services*, not given. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, said to be $500,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 110 lbs.

Financial.—Cost, $40,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $1,800. Ann. rev.: consumers, $3,000: city, $3,000. Hydrant rental, $45.

Management.—City Council, the Marshal superintending. Supt., D. J. Privett.

MOBILE, *Mobile Co.* (Pop., 29,132: est., 40,000.) On Mobile river, near its entrance to Mobile bay, on a level, sandy plain about 15 ft. above tide. Engaged in commerce and manufacturing.

THE MOBILE WATER-WORKS CO.'S SYSTEM.

In '40 works were built by —— Stein, who contracted to supply the city with water for 20 years, after which the city was to buy the works. No just settlement was made at the end of ~~the~~ that time, and the works go under the above name, although owned by Louis Stein, the son of the builder.

In '86-8 the Bienville Water Supply Co. built works under a state charter, and after their completion the Mobile Water-Works Co. brought a suit, claiming exclusive right to supply the city with water. The Supreme Court decided adversely.

General Description.—No data has been given by this Co. since '85, when water was pumped from three Mile creek and spring to a stand-pipe by a double-acting horizontal pump of 10-in. bore and 48-in. stroke, made by the West Point (N. Y.) Foundry Co., driven by two 16 ft. breast wheels; also by a Blake compound condensing pump of 14 and 24-in. steam, and 14-in. water cylinders, and 24-in. stroke. In '85 there were 22 miles of 10 to 3-in. cast-iron pipe, 150 hydrants, one meter and 1,200 taps. Service pipes were of lead. The works had cost $200,000, and the yearly operating expenses were $8,000. Louis Stein was then Supt.

BIENVILLE WATER SUPPLY CO'S. SYSTEM.

History.—Built in '86-8. Engr., C. Delafield. Contr. Saml. R. Bullock. Both of New York City.

Water Supply.—Clear creek, pumping direct or to reservoir.

Pumping Machinery.—Dy. cap., 12,000,000 galls.; two compound condensing Holly-Gaskill pumps.

Reservoir—Is 300 ft. in diam., at top, and 20 ft. deep.

Distribution.—*Mains*, c. i., 36 miles. *Services*, w. i., lead. Pipe and specials furnished by McNeal Pipe & Foundry Co., Burlington, N. J., and Florence Iron Works, Philadelphia, Pa. *Taps*, 527. *Meters*, 12. *Hydrants*, Ludlow, 260. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $825,000. Capital stock, $500,000. Bonded debt, $750,000. Int. 6%. Ann. op. exp. and rev. from consumers, not determined. Hydrant rental, $50.

Management.—Prest., Geo. A. Ketchum. Treas., E. Woltmann. Secy., A. Pope St. John. Supt., Jno. G. Friend. [illegible]

MONTGOMERY, *Montgomery Co.* (Pop., 16,713; est., 33,000.) On Alabama river at the head of navigation, on a high bluff. High water in the river is 162 ft. above the Gulf of Mexico. Has manufactories. Laid out in '17.

History.—Built in '73 by the Montgomery Water-Works Co. Chartered by the State Legislature. In '80 the works and franchises were bought by Geo. H. Hazlehurst and associates and reorganized as the Montgomery Water-Works. From the start the system was inadequate, and Oct. 7, '85, the City Council contracted with A. H. Howland, Boston, for the construction and maintenance of a new system. The Capital City Water Co. was organized, and works built in, '86-7, with A. H. Howland as Engr. and Contr.

The supply for the old works was pumped from the Alabama river through a 10-in. main to the city distribution, the surplus going to a reservoir 1¼ miles from the pump, 184 ft. above mean low water in the river, and at an average elevation of 100 ft. above the business portion of the town. At first water was taken directly from the river throughout the year, but later a filter was constructed for use when the water was muddy. There was a 1,000,000-gall, Worthington pump, located in the pump-well, with boilers above. The reservoir had a cap. of 4,000,000 galls. was in embankments with inner slopes 2 to 1, and outer, 1½ to 1. and with a promenade 20 ft. wide on top of the banks.

In '81 there were about 10 miles of 10 to 3-in. cast-iron mains, 100 hydrants and 550 private consumers. The new works are described below.

Water Supply.—Artesian wells, discharging into reservoirs, thence by pumping through distributing mains to stand-pipe. In '86 there were six 8-in. wells having a dy. cap. of 5,000,000 galls. Two were 635, two 443, and two 280 ft. deep, each pair of wells taking water from a different stratum, but the quality of the water in each being the same.

Reservoir.—Cap., 3,500,000 galls.; in embankments lined with masonry and divided by a masonry wall into two compartments.

Pump House.—Brick, with iron truss roof, two stories high; 80 by 50 ft., with smoke stack 105 ft. high, having 25 ft. of flue area. The building is fireproof.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; one duplex compound condensing, and one high-pressure Deane pump. There are six 80 H. P. steel boilers.

Stand-Pipe.—Cap., 417,000 galls.; wrought iron, 26 ft. in internal diam., 105 ft. high, and 250 ft. above high water in the river.

Distribution.—*Mains*, c. i.,41 miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 1,400. *Meters*, 756. *Hydrants*, Coffin, 275. *Valves*, Coffin. *Pressure gauge*, Edson.

Consumption, about 1,225,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 110 lbs.

Financial.—Capital stock, $350,000. Bonded debt, $350,000. Int., 6%. Ann. op. exp., $33,000. Ann. rev.: consumers, $25,000; city, about $15,000. Hydrant rental, $55.

Management.—Prest., J. W. Dimmick. Treas., A. H. Howland, Boston. Supt., W. F. Ellis.

SELMA, *Dallas Co.* (Pop., 7,529; est., 12,000.) On Alabama river, in cotton district, and is a center of cotton, lumber, iron and coal trade.

History.—Built in '86 by Selma Water Co., under a 30 years' franchise. Des. Engr., Wm. H. White, New York City. Const. Engr., C. A. White, St. Paul, Minn.

Water Supply.—Artesian well, pumping to stand-pipe and direct.

Reservoir.—Is 14 by 174 ft., probably receives water from the wells.

Pumping Machinery.—Worthington, dy. cap., 2,000,000 galls.

Stand-Pipe.—Is 15 by 120 ft.; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. Pipe and specials furnished by Chattanooga (Tenn.) Foundry & Pipe Co., and trenching and pipe-laying done by C. A. White, St. Paul, Minn. *Taps*, 375. *Meters*, none. *Hydrants*, Ludlow, 107. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Capital stock, $122,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,000; city, $6,515. Hydrant rental, $65 for 85, and $45 for additional.

Management.—Prest., W. H. White, 32 Pine Street, New York City. Treas., J. Ensign Fuller. Secy., S. W. St. John, Selma. Supt., and Pumping En gr., Thos. K. Gatchell.

SHEFFIELD, *Colbert Co.* (Pop., est., 3,000.) A new town.

General Description.—Temporary works have been put in by the Sheffield Land, Iron & Coal Co., from which water is furnished free, as the Co. is building up the town. A more extensive system will probably be built. Engr. of present works, Chas. Boeckh, Atlanta. No further data given. Report by W. L. Chambers, V. Prest. of Co.

TALLADEGA, *Talladega Co.* (Pop., 1,233; est., 5,000.) Is 36 miles from Jacksonville.

History.—Built in '86 by Talladega Gas Light & Water Co., under a 25 years' franchise. Engr., Geo. P. Anderton, the present Secy., of the Co.

Water Supply.—Spring, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. pumps made at Birmingham (Ala.) Iron Works.

Stand Pipe.—Is 14 by 120 ft.

Distribution.—*Mains*, c. i., 4 miles. *Services*, lead. *Taps*, 163. *Meters*, none. *Hydrants*, kind not given.

Consumption, 40,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 90 lbs.

Financial.—Cost, $40,000. Capital stock, $60,000. Bonded debt, $40,000. Int., not given. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $2,580. Hydrant rental, $60.

Management.—Prest., Jos. A. Shakespeare. Secy., Geo. P. Anderton. Supt. and Pumping Engr., Jas. M. Scott.

TROY, *Pike Co.* (Pop., 2,294; est., 3,000.) Has considerable cotton trade.

TEMPORARY WORKS.

In '86 the town laid two miles of iron pipe from a spring, put in a small pump and built a tank 6 by 10 ft., by 4 ft. deep. This was done at a cost of $1,200, and as an experiment, only, the intention being to make a contract with some Co. for a complete system.

PERMANENT WORKS.

History.—Begun in '88 and to be finished May 1, '89, by Troy Water-Works Co., under a 30 years franchise. Engr., J. Walrke Bates, 47 Liberty St., New York City. Contr., Scovel & Irwin, Nashville, Tenn.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; duplex, furnished by Gordon Steam Pump Co.

Stand-Pipe.—To be 16 ft. in diam. and 125 ft. high.

Distribution.—*Mains*, 12 to 6-in., 2½ miles. *Hydrants*, 30. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $70,000. Capital stock, $70,000. Bonded debt, $80,000. Int., 6%.

Management.—Address J. Walker Bates, 47 Liberty St., New York City.

TUSCALOOSA, *Tuscaloosa Co.* (Pop., 2,418; est., 5,000.) On Black Warrior river at head of steamboat navigation, in a cotton district.

History.—Built in '88 by Tuscaloosa Water-Works Co., under a 30 year's franchise. Engr., A. E. Boardman, of the Jeter & Boardman Gas & Water Assoc., Macon, Ga., the Contrs.

Water Supply.—Warrior river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington pump.

Tank.—Cap., 135,000 gall.; on tower.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 120. *Meters*, not given. *Hydrants*, Mathews, 50. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $106,000. Capital stock, $75,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, $60.

Management.—Prest., J. W. Wilcox. Secy., W. C. Fitts. Treas., A. E. Boardman, Macon, Ga. Supt. W. V. Todd.

Water-Works Projected with Fair Prospects of Construction.

CALERA, *Shelby Co.* (Pop., 889; est., 1,500.) In coal and limestone region, and is engaged in manufacturing.

Proposed System.—Water to be pumped from artesian well, with a flow of 1,250 galls. a minute, to a reservoir. Est. cost, $50,000. A reservoir has been built by Calera Land Co., and an artesian well sunk. Further work is not definitely decided upon but will probably be done in a few months from Nov., '88. Report by J. R. Adams, Montgomery.

CULLMAN, *Cullman Co.* (Pop., 426; est., 2,100.) In fruit and agricultural district.

Proposed System.—An artesian well has been sunk 1,400 ft. and a 50,000-gall. pump purchased by the Cullman Land & Improvement Co. Further details of the system were not decided upon Nov. 5, '88. Address Parker & Co.

MARION, *Jefferson Co.* (Pop., est., 2,500.) In cotton region, 30 miles northwest of Selma.

Proposed System.—No details given, but the corporate authorities are talking of building works. City Clerk, R. Yeatman.

OXFORD, *Calhoun Co.* (Pop., 780; est., 1,500.) Is 3 miles from Anniston.

Proposed System.—To be supplied from Anniston. Address T. C. Hill, or J. Draper.

UNIONTOWN, *Perry Co.* (Pop., 810; est., 2,000.) In cotton and canebrake region.

Proposed System.—Artesian well to cost $4,000 or $5,000, and be paid for by town bonds. It is not stated whether a distribution system will be put in. Contracts for the well to be let about the middle of Nov., '88, and work to begin as soon as possible. Chairman Water Board, M. L. Ernst. Report by J. C. Welch, Mayor.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Atalla, *Etawah Co.*; De Armanville, *Calhoun Co.*; Fort Payne, *De Kalb Co.*; Lake View, *Covington Co.*; Tuscumbia, *Colbert Co.*; Warrior, *Jefferson Co.*

Water-Works Completed or in Process of Costruction.

MISSISSIPPI.

COLUMBUS, *Lowndes Co.* (Pop., 3,995; est., 5,760.) On Tombigbee river, which is navigable for steamboats to this point. Settled in '19.

History.—Built in '67 by city.

Water Supply.—Two artesian wells, pumping to reservoirs. The first well is 4-in. in diam. and has a dy. cap. of 150,000 galls. The second one was bored in '88.

Pumping Machinery.—Dy. cap., 100,000 galls.; two No. 7 Knowles pump.

Reservoir.—Cap., 90,000 galls.; of brick, 20 ft. in diam. and 25 ft. deep.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 200 *Meters*, 4. *Hydrants*, kind not given, 22.

Consumption, 100,000 galls. *Pressure*: 20 lbs.

Financial.—Cost, $25,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,500; city, none.

Management.—Supt., A. S. Frierson.

GREENVILLE, *Washington Co.* (Pop., 2,191; est., 2,500.) On Mississippi river in cotton district.

History.—Built in '88 by Greenville Water Works Co., under a 30 year's franchise. Engr., Louis Metesser, New Orleans, La. The Co. does the work, except pipe-laying.

Water Supply.—Artesian well with Mississippi river as reserve, by direct pumping.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; two compound Gordon pumps and boilers from Heine Safety Boiler Co.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, lead, iron. Pipe and specials furnished by Addyston Pipe & Steel Co., Addyston, O. *Hydrants*, 65.

Financial.—Cost, about $70,000. Capital stock, $100,000. Bonds, $75,000. Int., not given. Hydrant rental, $60. Other data not determined.

Management.—Prest., Louis Metesser, New Orleans, La. V. Prest., Joshua Skinner. Secy, Jno. Finlay. Treas., A. Pollock. Supt., Jas. Burke.

NOTE:—No other data received in time for insertion here.

MERIDIAN, *Lauderdale Co.* (Pop., 4,008; est., 12,000.) Has railroad repair shops and some manufactories.

History.—Built in '86-7 by Meridian Water-Works Co., and controlled by American Water-Work & Guarantee Co., Limited, Pittsburgh, Pa. Engr., S. M. Highlands, Pittsburgh, Pa. The franchise is for 25 years.

Water Supply.—Springs and surface water, by pumping from collecting and storage reservoir.

Reservoir.—Cap., 200,000,000 galls.

Pumping Machinery.—Worthington compound pump, dy. cap., 2,500,000 galls.

Distribution.—*Mains*, c. i., 9.8 miles. *Services*, galv. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 190. *Meters*, 8. *Hydrants*, Ludlow, 90. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 90 lbs.

Financial.—Cost, $125,000. Capital stock, $150,000. Bonded debt, $110,000. Int., not given. Ann. op. exp., $2,400. Ann. rev.: consumers, $5,000; city, $4,500. Hydrant rental, $50.

Management.—Gen'l Mgr., W. S. Kuhn. Secy., S. M. Highlands. Both of Pittsburgh, Pa. Supt., Geo. B. Opp.

VICKSBURG, *Warren Co.* (Pop., 11,814; est., 15,000.) On Mississippi river. Engaged in river trade and has manufactories.

History.—Built in '87-8 by Vicksburg Water Supply Co. Engr., C. Delafield. Con'r., Saml. R. Bullock. Both of New York City.

Water Supply.—Mississippi river, pumping from settling basin, direct or to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; four compound condensing Deane pumps.

Stand-Pipe.—In 22 ft. in diam. and 145 ft. high; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky.

Financial.—Capital stock, $250,000. Bonded debt, $250,000. Int., 6%.

Management.—Prest., E. Woltmann, 11 Wall street, New York City. Treas., J. Holmes. Secy., C. M. Berrian. Supt., C. R. McFarland.

Water-Works Projected with Fair Prospects of Construction.

BILOXI *Harrison Co.* (Pop., 1,540; est., 2,500, and in summer, 8,000.) Is 8 miles from New Orleans. A manufacturing and shipping town.

Proposed System.—There has been talk of forming a Co., but nothing definite had been decided to Nov. 1, '88. It is thought that an artesian well sunk 500 ft. would give a flow of 60 galls. a minute. Report by L. B. Holly.

NATCHEZ, *Adams Co.* (Pop., 7,052; est., 10,000.) On Mississippi river. Has cotton mills, foundries and other manufactories.

Proposed System.—A contract for water-works was granted some time ago, and nothing having been done the City Council has since talked of building the works, but no action has been taken to Nov, 12, '88. A. L. Howe is Chairman of the Comm. on Gas and Water.

Water-Works Projects Reported in '87-'88, but now Indefinite.

Arcola, *Washington Co.*

Water-Works Completed or in Process of Construction.

LOUISIANA.

BATON ROUGE, *East Baton Rouge Co.* (Pop., 7,197; est., 10,000.) On Mississippi river.

History.—Built in '88 by Baton Rouge Water Co. Engr., E. Smedley, of Smedley & Wood, Dubuque, Ia. who were the Contrs.

Water Supply.—Source not given, pumping to stand-pipe.

Pumping Machinery. Dy. cap., 2,000,000 galls.; two 1,000,000-gall. pumps.

Stand-Pipe.—Steel, 100 ft. high.

Distribution.—*Mains*, 6 miles. *Hydrants*, 75.

Management.—Address Baton Rouge Water Co.

NOTE:—No official report received in time for insertion, save that the works are completed, with Contrs. as given above.

NEW ORLEANS, *Orleans Co.* (Pop., 216,090; est., 230,000.) On east bank of Mississippi river, 115 miles from its mouth, and on the west bank of Lake Pontchartrain.

The city limits have a frontage of 13 miles on a curve in the river, and of 7 miles on the lake, which is 5 miles distant. This area lies below the high water level of both river and lake, and is enclosed by levees, and drained by canals, the water being pumped over the levees. The built up part of the city lies along the river for about 6 miles, with an average width of 1½ miles. In '80 there were 26,500 dwellings within this area. Largely engaged in foreign and domestic commerce, especially in cotton trade, and has manufactories. Founded in 1718 by the French.

History.—Built in '33 by a private company, and now owned by the New Orleans Water Co.

In '33, when the works were built, the population was 70,000, and until then water had been taken from wells and cisterns. The Des. Engr. for the original works was Erastus W. Smith, who, with Albert Stein, of Mobile, Ala., was also Const. Engr. Albert Stein was also the Contr. for the first reservoir.

In '68 the city bought the works for $1,300,000, and in '78 sold them to the New Orleans Water Co., at the same time authorizing the issue of $600,000 of bonds for improvements. Moses Lane was Engr. for the latter work.

The company's exclusive privilege to supply the city with water has been confirmed by the U. S. Supreme Court, their rights extending to 1928.

Water Supply.—Mississippi river, pumping to reservoirs, stand-pipe and direct. One of the reservoirs serves as a settling basin. As late as '81 a large proportion of the population took their domestic supply from cisterns, filled with rain water.

Pumping Machinery.—Est. dy. cap., 34,000,000 galls.; furnished by Allaire Works, Variety Works, and a 5,000,000-gall. Knowles pump added in connection with the stand-pipe in '78.

Reservoirs.—Cap., 4,000,000 galls.; 1,000 ft. from pumps, giving very small head to the upper part of the city.

Stand-Pipe.—Is 7 ft. in diam. at base, and 174 ft. high; built by McRitchie & Nichol, Chicago.

Distribution.—*Mains*, c. i., 72 miles. *Services*, lead. Furnished, of late, by R. D. Wood & Co., Philadelphia, Pa., Dennis Long & Co., Louisville, Ky., and Chattanooga (Tenn.) Foundry and Pipe Works. Trenching and pipe-laying done by the company. *Taps*, 4,400. *Meters*, 8. *Hydrants*, Holly, 1,191. *Valves*, Chapman now used exclusively. *Pressure gauge*, Edson.

Consumption, 6,000,000 galls. *Pressure*, Ordinary, 25 lbs. Fire, 25 lbs.

Financial.—Cost, $2,397,000. Capital stock, $2,000,000. Bonded debt, $395,000. Int., 6%. Ann. op. exp., $39,640 for '86. Ann. rev.: consumers, $187,000 in '86; city, $69,600. Hydrant rental, $60 each for 1,160.

Management.—Prest., R. E. Craig. Supt., L. H. Gardner.

SHREVEPORT, *Caddo Co.* (Pop., 8,009; est., 16,000.) On Red river, in cotton region, and is engaged in river and other trade.

History.—Built in '86-7 by Shreveport Water-Works Co., under a 30 years' franchise. Engr., E. F. Fuller. Contr., Saml. R. Bullock. Both of New York city.

Water Supply.—Cross Bayou, pumping to settling basins and stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two single and two horizontal compound Blake pumps, and Abendroth & Root boilers.

Settling Basins.—Two, of 1,250,000 galls. each.

Stand-Pipe.—Is 20 ft. in diam. and 110 ft. high; furnished by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 434. *Meters*, none. *Hydrants*, Ludlow, 106. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 86 lbs. Fire, 175 lbs.

Financial.—Cost, $250,000. Capital stock, $250,000. Bonds, $250,000. Int., 6%.

Ann. op. exp., not determined at time of report. Ann. rev.: consumers, $9,000; city, $8,800. Hydrant rental, $50.

Management.—Prest., Saml. R. Bullock. Treas., E. Woltmann. Secy., N. P. Hobart. Supt., T. E. Baker.

Water-Works Completed or In Process of Construction

TENNESSEE.

ATHENS, *McMinn Co.* (Pop., est., 2,500.) In an agricultural region.

History.—Built in '88 by Athens Mining and Mfg. Co. Contrs., Union Iron Works, Chattanooga.

Water Supply.—Ingleside Spring, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 500,000 galls.; duplex pump and return tubular boiler.

Stand-Pipe.—Cap., about 50,000 galls.; is 12½ ft. in diam., and 70 ft. high. Built by Contrs.

Distribution.—*Mains*, 4 miles.

Financial.—Cost, $25,000. No capital stock or bonds.

Management.—Prest., F. B. McElma. Secy. and Genl. Mgr., R. J. Fisher.

No other data given.

BRISTOL, *Sullivan Co.* (Pop., 1,647; est., 3,000. Est. pop. supplied, 7,000.) On Virginia State line. Has tobacco warehouse and factories, and cotton and woolen mills.

History.—Built in '88 by Bristol-Goodson Water Co. to supply Bristol, and Goodsoon, Va. Engr. and Contr., W. W. Taylor, Philadelphia, Pa.

Water Supply.—Spring issuing from limestone, pumping to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; two Silsby pumps.

Tank.—Cap., 100,000 galls.; of white Juniper, placed on tower. Contr., Geo. Woodford, Philadelphia, Pa.

Distribution.—*Mains*, 4 to 12-in. c i., 5½ miles. *Services*, galv. i. Pipe and specials furnished by South Pittsburg Pipe Works. *Taps* and *Meters*, not determined. *Hydrants*, Taylor, about 35. *Valves*, W. S. Payne & Co.'s.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Capital stock, $75,000. Bonded debt, $40,000. Int., 6%. Hydrant rental, $40 for first 25, and $35 for additional. Other data not determined.

Management.—Prest., Saml. L. King, Bristol. Treas., F. B. Hubbell, Baltimore, Md.

BROWNSVILLE, *Haywood Co.* (Pop., est., 4,500.) Is five miles from Hatchet river in a cotton district.

History.—Built in '88-9 by Brownsville Water-Works Co., under a 30 year's franchise. Engr., J. Walker Bates. Contrs., J. Walker Bates & Co., New York City.

Water Supply.—Dug wells, pumping to stand-pipe.

Pumping Machinery.—Dean duplex, dy. cap., 1,000,000 galls.

Stand-Pipe.—Is 20 ft. in diam. by 125 ft. high; furnished by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, 12 to 6 in., kind not given. *Services*, not given. Pipe and specials furnished and laid by Scovel & Irwin, Nashville. *Taps*, not determined. *Meters*, Thompson, number not given. *Hydrants*, Bourbon, 30. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $100,000. Capital stock, $50,000. Bonded debt, $100,000. Int. 6%. Hydrant rental, $33.34.

Management.—Address J. Walker Bates, 47 Liberty St., New York City.

CHATTANOOGA, *Hamilton Co.* (Pop., 12,892; est., 40,000.) On Tennessee river, on limestone hills rising 300 ft. above the water. Has iron and various other manufactories. Settled in '40; incorp. in '50.

History.—Built in '64 by the U. S. Government, and purchased soon after by a private company, which operated them a short time, failed, and then sold them to the Lookout Water Co. In '86 or '87 the works came under the control of the American Water-Works & Guarantee Co., Limited, Pittsburgh, Pa., the local name being the City Water Co. In '87-8 a new pumping plant was put in two miles up the river.

Water Supply.—Tennessee river, filtered, then pumped to reservoir.

At one time the city was wholly or partially supplied from a tunnel driven into Lookout Mountain, 600 ft. above low ground.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; two Knowles, and one 6,000,000-gall. Deane pumps, the latter placed in '88.

The first pump was a Woodward of 18-in. steam and 9-in. water cylinder, and in '71 a duplex pump of the same kind and size was added. In '77 another duplex pump of 20-in. steam and 12-in. water cylinders was placed, and in '81 a Worthington with 20-in. steam and 14-in. water cylinders, of 30-in. stroke. It is not stated whether all these old pumps have been abandoned.

Filters.—National Water Purifying Co.'s plant, dy. cap., 3,000,000 galls. There are ten No. 17 filters. They are cleaned in sets of two, using a 4-in. pipe with 45 lbs. pressure, and requiring no labor save that of operating the valves. Each set of two can be cleaned in 24 minutes, or the whole plant in about 2 hours.

Reservoir.—Cap., 3,000,000 galls.; in two compartments, 150 wide, 125 and 160 ft. long, respectively; 12 ft. deep, 175 ft. above the river and 125 ft. above the business part of the city. Lined with puddle and paved with brick. The compartments can be filled and emptied alternately, which was very necessary before the filters were placed, that the water might settle.

Distribution.—*Mains*, c. i., 37½ miles. *Services*, galv. i., lead. *Taps*, 2,850. *Meters*, 20. *Hydrants*, Ludlow, Mathews, 150. *Valves*, Ludlow, Eddy. *Pressure gauge*, Edson.

Consumption, 3,000,000 galls. *Pressure*; Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $600,000. Capital stock, $500,000. Bonded debt, $469,000. Int., 6%. Ann. op. exp., withheld. Ann rev.: consumers, withheld; city, $5,000 during the first five years of the contract, $7,000 for the next, and $9,000 for the last.

CLARKSVILLE, *Montgomery Co.* (Pop., 3,880; est., 7,500.) On Cumberland river, on a high bluff of white limestone and red clay, which is intersected by deep ravines. Largely engaged in raising, manufacturing and shipping tobacco. Settled in 1785.

History.—Built in '79 by Travers Daniels, and purchased by Clarksville Water Co. in Aug., '83. Mr. Daniels was Des. and Const. Engr.

Water Supply.—Cumberland river, pumping to stand-pipe.

Pumping Machinery.—The first was a Blake pump of 16 in. bore lifting water 275 ft. A Blake and Dean pump have been added.

Stand-Pipe.—Is 15 ft. in diam., 102 ft. high, placed on the highest ground in the city.

Distribution.—*Mains*, 8 to 4-in. c. i., 8 miles. *Services*, w. i., lead. *Taps*, 310. *Meters*, Union, 5. *Hydrants*, Chapman, 43.

Consumption, not given. *Pressure*: 55 lbs. *Valves*, Chapman.

Financial.—(In '82.) Cost, $45,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $2,000. Hydrant rents, $50.

Management.—Prest., F. P. Gracey. Secy. and Treas., B. W. Macrae. Supt., R. E. McCulloch.

COLUMBIA, *Murray Co.* (Pop., 3,400; est., 5,000.) On Duck river, in a mountainous district, 46 miles from Nashville. Has cotton and furniture factories and flouring mills. Settled in '19; chartered in '48, and again in '69.

OLD CITY WORKS.

General Description.—Built in '40, taking supply from springs and pumping it 150 ft. high to a brick and stone reservoir 20 by 30 ft., 11 ft. deep, and 80 ft. above the city. In '82 the pumping machinery in use was a Cope & Maxwell pump, erected in '77, and a Deane pump erected in '79. There were at that time 6 miles of 3-in cast-iron pipe, 120 taps, 1 meter, 2 hydrants and 6 gates. The cost of the works was unknown. The ann. op. exp. was $3,000, and the receipts $1,500.

COLUMBIA WATER CO.'S WORKS.

History.—Bought in '84, and extended and improved with C. H. Ledlie, St. Louis, Mo., as Const. Engr.

Water Supply.—Duck river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; one Blake and one Deane pump, 1,000,000 galls. each. New pumping machinery was purchased in '84.

Reservoir.—Cap., 700,000 galls. The old reservoir, described above, was enlarged to this capacity.

Distribution.—*Mains*, c. i., Kalamein iron, 6½ miles. *Services*, w. i. *Taps*, 185. *Meters*, 8. *Hydrants*, Ludlow, Chapman, 44. *Valves*, kind, do.

Consumption, 135,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 lbs.

Financial.—Capital stock, $50,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., about $3,600. Ann. rev.: consumers, $4,500; city, $3,300. Hydrant rental, $70 for first 40, and $50, for all additional.

DYERSBURG, *Dyer Co.* (Pop., 1,010; est., 1,500.) On Forked Deer river. Has carriage factory foundry, steam flouring and saw mills.

History.—Being built in '88. Address Frank Shephard.

JACKSON, *Madison Co.* (Pop., 5,377; est., 10,000.) On Forked Deer river. Has railroad repair shops, cotton-seed oil, woolen and flour mills, ice and hub factory, and a foundry.

History.—Built in '85 by city.

Water Supply.—Twenty-two bored wells, by direct pumping. There is talk of adding a stand-pipe.

Pumping Machinery.—Knowles compound duplex pump, dy. cap., 1,000,000 galls.; tubular boilers.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i. *Taps*, 450. *Meters*, Crown, 3. *Hydrants* Ludlow, Mathews, 132.

Consumption, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 115 lbs.

Financial.—Cost, $100,000. Debt, $100,000. Int., 6%. Ann. op. exp., $4,800. Ann. rev.: consumers, $8,000; city, none.

Management.—Water Board. Prest., J. H. Durke. Supt. and Secy., W. T. Harris.

KNOXVILLE, *Knox Co.* (Pop., 9,693; est., 40,000.) On the Tennessee river, at the head of steamboat navigation. Has large marble industries, saw mills, iron and nail works, cotton and woolen mills, and railroad and car shops.

History.—Built in '83 by Knoxville Water Co. Des. Engr., Moses Lane. Const. Engr., Lockett & Fuller, and for remodeling in '84, A. H. Marine, the present Supt. Labor done by the company. The city has the privilege of buying the works at the end of 30 years.

Water Supply.—Tennessee river, pumping to reservoir. Direct pumping can be used.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound condensing Davidson pumps, and two horizontal boilers.

Force Main.—Of 14 in. cast-iron, 2,300 ft long, with two right angle bends. It enters the settling basin of the reservoir, and also connects with the effluent pipe, so direct pumping can be used.

Reservoir.—Cap., 3,000,000 galls.; in earth, with division wall forming two equal compartments. The division wall is 10 ft. wide on top, with slopes of 1 to 1, and the main inner slopes are 1½ to 1. Upon a hill 231 ft. above low water in the river, and from 100 to 110 ft. above the thickly built part of the city. The excavation was through tough red clay with a slight admixture of sand and considerable quantities of small stone. The excavated material was used in the banks, and selected portions to puddle the sides and bottom. On the slopes there was 15 in. of puddle covered with 4-in. of road metal, upon which cement was placed and a brick lining set. The bottom was also puddled and covered with road metal. By boring, it was found that at no part of the bottom was there less than 20 ft. of clay above the rock.

Water was first pumped to the reservoir May 28, '83, and until June 2 no leaks were discovered, but on the evening of that day there was a break in the bottom of the north compartment, about 20 ft. sq., which let out all the water and carried about 300 cu. yds. of earth, puddle and rock into the cavities of the limestone rock below. Three days later the south compartment broke in a similar way, the hole being larger. Water was temporarily supplied by direct pumping, but some passing to the south compartment it was found that the earth had filled the cavity, allowing repairs to be made in the other division, that to be filled, and then the second one repaired.

The reservoir broke six times more, and water was finally kept at a depth of but 8 ft.

After the first of the breaks the reservoir was lined with brick laid in mortar made of partly set cement and river sand, with mud and sticks in it. This did not prove effectual, and the work was reconstructed in '85 by the Supt., A. H. Martine, he using for his mortar Portland cement and clean sharp sand. For the past three years the reservoir had held water to its full capacity. A very full account of the first breaks and the repairs is given by one of the Const. Engrs., E. F. Fuller, in *Eng. News*, vol. XI, pp. 92-3.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i. Pipe and specials furnished by Chattanooga (Tenn.) Foundry and Pipe Works. *Taps*, 926. *Hydrants*, Ludlow, Coffin, about 120. *Valves*, Ludlow, Coffin.

Consumption, 1,083,000 galls. *Pressure*: Ordinary, 47 lbs. Fire, 47 lbs.

Financial.—Cost, unknown. Capital stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $8,431. Ann. rev.: consumers, $15,912; city, about $6,000. Hydrant rental, $50.

Management.—Prest., R. N. Hood. Treas., C. M. McClung. Supt., A. H. Martine.

MEMPHIS, *Shelby Co.* (Pop., 33,592; est., 70,000.) On the Mississippi, just below the mouth of the Wolfe river, on the fourth Chickasaw bluffs, about 35 ft. above the highest floods. The ground falls from the summit ridge to the Mississippi on one side, and to Bayou Gayoso on the other. The Mississippi is navigable to this point for the largest steamboats all the year. Laid out in '20; incorp. a city in '27.

History.—Built in '72 by a private company, purchased and extended in '80 by the Memphis Water-Works Co., and sold by them to the Artesian Water Co. in '88, who at once began extending the system with Thos. J. Whitman, St. Louis, Chf. Engr., and Thos. J. Johnson, formerly of Chicago, Resident Const. Engr.

For the works built in '72 A. R. Ketcham was Consulting Engr., and Galen W. Pearsons, Kansas City, Mo., Const. Engr.

GENERAL DESCRIPTION OF WORKS FROM '72 TO '80.

Water was taken from Wolfe river, two miles north of the city, by direct pumping for the main supply, a portion going to a 3,000,000-gall. reservoir near the engine house and being pumped from this for fire protection.

Filtering trench and crib, receiving well, tunnel and pump-well.—For 150 ft. at the foot of the bluff along the river two rows of 12 to 14-in. piles, 30 ft. long, were driven 18 ft. into the ground, the rows being 8 ft. apart, and the piles 4 ft. apart in the rows.

They were connected longitudinally by timbers, then sheet-piling was driven along each row, and between them a filtering trench was made, 3½ ft. wide, 4 ft. deep, with brick walls, plank top and bottom, and a covering of 5 ft. of gravel. A timber filtering crib 60 ft. wide was extended into the river, filled with gravel, and covered with plank and gravel. On the shore side of the filtering trench a well was sunk 18 ft. in diam. and 23 ft. deep, with 21 in. brick walls on a timber shoe. It was excavated as the curb was set, and being through gravel and quicksand the job was difficult.

From this well a tunnel, 130 ft. long and 12 ft. below low-water mark and containing a 20-in. suction pipe, was run into the bluff to a pump-well, sunk from the surface, 18 ft. in diam. at the top and 60 ft. deep, lined with plate-iron. The excavation was made 24 ft. in diam. for the first 30 ft., then reduced to 15 ft. and carried down with sloping sides for 16 ft., the last 14 ft. being 10 ft. in diam. This gave room at the top for a staging inside the excavation, but outside the plate-iron tube, which was built on the staging, suspended by screw-rods from a truss overhead, and lowered as successive plates were added at the top.

Pumping Machinery.—Eight 20-in. pumps of 24-in. stroke were placed at the bottom of the pump-well, drawing water from the receiving well and filter through the 20-in. suction-pipe in the tunnel, and forcing it directly to the mains. The pump-rods extended to the top of the well and were there operated by cranks attached to a shaft geared to a Holly engine with two 21-in. cylinders of 33-in. stroke. At the surface there were two rotary pumps, used only for fire protection, taking their supply from the 3,000,000-gall. reservoir near by, which was filled by the other pumps.

The supply furnished by the first company was not satisfactory in quality or quantity, the filtering apparatus proving ineffective and the pumping machinery insufficient. The company laid 17 miles of pipes, and the original cost of the works was $472,278. In '80 they sold the system to the Memphis Water-Works Co. for $200,000.

THE MEMPHIS WATER CO.'S WORKS.—Operated from '80 to '87.

Bought as stated immediately above, and reconstructed on a new plan, taking the supply from Wolfe river.

Intake Pipe, tunnel and pump-well.—A 24-in. pipe was laid from the river, through a tunnel 200 ft. long, to a pump-well 18 ft. in diam., 61 ft. deep, lined with brick, resting on a cast-iron shoe.

Pumping Machinery.—At the bottom of the well were placed four double-acting plunger pumps of 16-in. bore and 36-in. stroke, with pump rods carried to the top and connected with two Holly-Gaskill engines, each having two pairs of 24-in. steam cylinders of 36-in. stroke, and the piston rods of each pair being connected to cranks on a fly-wheel shaft. There was an air chamber on the suction, and another on the discharge pipe. The pumps delivered directly to the mains.

As this system was bought by the Artesian Water Co. in '88 other details are given in their proper place below.

THE PRESENT OR ARTESIAN WATER CO.'S WORKS.

Water Supply.—Artesian wells, pumping direct and to stand-pipe. It is unofficially reported that the wells are 6-in. in diam., and 50 ft. apart. This supply was introduced in '88, water having been previously taken from Wolfe river as describ edunder the Memphis Water Co.'s system.

Pumping Machinery.—*Old plant*: Dy. cap.,9,000,000 galls.: several kinds, taking water from Wolfe river. *New plant*: Dy.cap.,30,000,000 galls.; three 10,000,000-gall. Worthington pumps built in '88.

Reservoir.—Cap., 3,000,000 galls.: used in connection with old plant.

Stand-Pipe.—Is 36 ft. in diam. and 160 ft. high; furnished by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 60 miles. *Services*, galv. i., lead. Pipe and specials furnished to present company by Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by M. Philbin, Chicago, Ill. *Taps*, 4,500. *Meters*, 240. *Hydrants*, Ludlow, Chapman, Eddy, Holly, 350. *Valves*, kind, do.

Consumption, 6,000,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 30 lbs.

Financial.—Cost, $850,000. Capital stock, $750,000. Bonded debt, $100,000. Int. 6%. Ann. op. exp., withheld. Ann. rev.: consumers, $100,000; city, $30,000 for all purposes, a 20 years' contract.

Management.—Prest., T. J. Latham. Secy., Lawrence Simpson. Supt., W. L. Cameron. Pumping Engr., Harry Lanham.

MONTEAGLE, *Grundy Co.* (Pop., est., 500.) A summer resort.

History.—Built in '88 by the Nashville, Chattanooga & St. Louis Ry. Co. to supply their watering station and the summer visitors.

Water Supply.—Spring, pumping to tank.

Pumping Machinery.—Dy. cap., not given; Worthington pump, lifting water 490 ft. through a mile of pipe.

Tank.—Cap. not given.

Distribution.—Not given.

Financial.—Not given.

Management.—Nashville, Chattanooga & St. Louis Ry. Co., offices, Nashville Report by Asst. Engr., B. S. Blackie, Nashville.

MURFREESBORO, *Rutherford Co.* (Pop., 3,800; est., 4,000.) Is 32 miles from Nashville.

General Description.—Built for fire protection in '88.

Source is not given, but direct pumping is used. No further data given. Address Chairman Fire Comm., W. B. Garrett or the Mayor.

NASHVILLE, *Davidson Co.* (Pop., 43,350; est., 80,000.) On south bank of Cumberland river, on rocky bluffs rising from 80 to 175 ft. above low water. Has cotton-seed oil mills, iron foundries, stove works, machine shops, rolling and cotton mills, iron furnaces, charcoal works, and other manufactories. Settled in 799; incorp. a town in '06.

History.—Built in '32 by town, when population was about 6,000. Des. Engr., Albert Stein. A new pumping plant, filter and reservoir added in '88.

Water Supply.—Cumberland river, pumping to stand-pipe and reservoir.

Pumping Machinery.—Dy. cap., 20,000,000 galls. *Old Station*: Four 2,500,000-gall. compound condensing Worthington pumps are in use, and there is a horizontal engine with vertical pumps having a cap. of 4,000,000 galls., placed in '55, and now kept as a reserve. The cylinder of this pump is 24 in. in diam. and 10 ft. long. The first pump was direct-acting, and had a 26-in. cylinder of 96 in stroke.

In '78 two duplex Dean pumps were placed, but these are not used. There are two batteries of 5 boilers each at the old station, those in the first battery being 18 by 4½ ft., and in the new, 20 by 6 ft. The first stack is 100, and the second 139 ft. above the grate.

New Station: Built in '88 and has a 10,000,000-gall. Holly-Gaskill pump working against 300 ft. head, and having a guaranteed duty of 72,000 galls. based on an evaporation of 8 lbs. of water. The buildings at this station cost $100,000, and the pump the same. There are six tubular boilers, 18 by 5½ ft., built by the Union Iron Works, Chattanooga.

Filter Gallery.—Is 2,000 ft. long, 4 ft. wide, 7 to 10 ft. deep, and has an est. dy. cap. of 10,000,000 galls. Finished in '88 at a cost of $46,000.

Old Reservoir.—Cap., 2,500,000 galls. In '84 a test was made by Olin H. Landreth of the leakage of the reservoir, which was found to be over 1,300,000 galls. a day. Further investigations and repairs were advised, but it is not stated whether these were made. The reservoir is only 177 ft. above low water in the river, while some points are 176, 165 and 160 ft. above the same level.

New Reservoir.—Cap., 50,000,000 galls. Of masonry, 2½ miles from pumping station, and 300 ft. above low water in river. Estimated cost, $330,000. In progress in '88, with Whitsitt & Adams as Contrs.

Stand-Pipe.—For regulating pressure. Is 3 ft. in diam. by 114 ft. high, encased in brick, having an inside circular wall fitting around the pipe, and an outside wall 13 in. thick, 12 ft. sq. at the base, and tapering to 5 ft. and 2 in. at the top. There is a space between the two walls for about 90 ft. from the bottom, where they join. The structure is on a bluff 160 ft. high, and has stood well.

Distribution.—*Mains*, 3 to 36-in. c. i., 42 miles. Nov. 11, '86, a 24-in. main burst, the piece blown out having an area of about 4 sq. ft. The break was in the bottom of the pipe, which rested on sand and clay. There was no flaw in the pipe, and the pressure was not over 65 lbs., unless caused by water ram. *Services*, c. i., lead. *Taps*, 4,321. *Meters*, 8. *Hydrants*, Ludlow, Mathews, 300. *Valves*, Eddy, Galvin.

Consumption, 8,522,762 galls. *Pressure*: 10 to 60 lbs.

Financial.—Cost, about $2,000,000. Bonded debt, $600,000: $125,000 at 4½, and $4,575,000 at 6%. To '81 the cost of the works had been $1,500,000, and the gross receipts $1,215,227. There was no bonded debt the first of 80, but $75,000 of bonds were issued that year. Ann. op. exp., $43,228. Ann. rev.: consumers, $80,773; city, none.

Management.—Board of Public Works and Affairs. Chairman, Robt. Ewing. Supt., Geo. Reyer.

NOTE:—See *Eng. News*, vol. 19, p. 484 for an extended description of the new reservoir.

SOUTH PITTSBURG, *Marion Co.* (Pop., 1,045: est., 3,500.) On Tennessee river, 27 miles from Chattanooga.

History.—Built by private company, and now owned by South Pittsburg City Co., date not given. Engr., W. Manthey, deceased.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 34,000 galls.

Distribution.—*Mains*, c. i., 4 miles; supplied by South Pittsburg Pipe Works. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, no special kind, 16.

Consumpton, 70,000. *Pressure*: Ordinary, 80 lbs. Fire, 180 lbs.

Financial.—Cost, debt and int., not given. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,000; city, none.

Management.—Prest., Jas. L. Gaines, Nashville. Engr. and Supt., F. P. Clute.

Water-Works Projected with Fair Prospects of Construction.

CLEVELAND, *Bradley Co.* (Pop., 1,874; est., 3,200.] Is 30 miles from Chattanooga, and has manufactories.

Proposed System.—Address Jno. H. Craigmiles, who proposes to build works.

GALLATIN, *Sumner Co.* (Pop., 1,938; est., 3,500.) Is 26 miles from Nashville. Manufactures flour, cotton and woolen goods, spokes, axe-handles, chairs, and agricultural implements.

Proposed System.—To pump from wells to stand-pipe, the town to issue from $10,000 to $15,000 of bonds to cover cost of works.

JOHNSON CITY, *Washington Co.* (Pop., 685; est., 3,000.) Is 25 miles west of Bristol. Has tannery, sash, blind and furniture factory, machine shops and foundry.

Proposed System.—A large spring with a dy. cap. of 1,000,000 galls., and a site for reservoir were bought in '88 by F. A. Stratton, and work begun on the reservoir for a gravity system. Nov. 1, '88, work had been stopped until a contract for hydrants should be made with the town. Mr. Stratton intends to finish the works himself, or turn over bonds to some party who will do so. The reservoir will be 22 ft. below the spring, and 143 above the street curbs. It is three miles from the center of the town, and a 12-in. main will be laid that distance. Address F. A. Stratton.

MORRISTOWN, *Hamblen Co.* (Pop., 1,350; est., 4.000.) Has flouring mill and sash and blind factory.

Proposed System.—Works are badly needed, and several propositions have been made by contractors, and some prospecting done. Chairman Water Comm., J. C. Hodge. Report by W. A. Jones.

TULLAHOMA, *Coffee Co.* (Pop., 1,083; est., 3,000.) Has woolen mill, hub, spoke, handle, file and mattress factories, and planing mills.

Proposed System.—Two large springs 70 ft. below street level, pumping to reservoir, with about 10 miles of mains. Est. cost, $25,000. Works will probably be built by company. Nothing had been done Nov. 14, '88. Address Geo. W. Davidson

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Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Jonesboro, *Washington Co.*; Pulaski, *Giles Co.*; Troy, *Obion Co.*; Union City, *Obion Co.*

Water-Works Completed or in Process of Construction.

KENTUCKY.

BELLEVIEW, *Christian Co.* (Pop., est., 3,000.)

History.—Built in '87 by Belleview Water and Gas Co. taking the supply from the Newport water-works. The contract with the Newport gives an exclusive right to water for 25 years at 7 cents for each 1,000 galls. The franchise also runs for 25 years.

Water Supply.—Newport water-works, as stated above.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. *Taps*, 160. *Meters*, 2. *Hydrants*, kind not given, 40.

Consumption and *Pressure*: not given.

Financial.—Cost, $35,000. Bonded debt on water-works, $7,000. Int., 6%. Ann. op. exp., not given. Ann rev.: consumers, withheld; city, $1,000. Hydrant rental, $25.

Management.—Prest., Wm. W. Post, Supt., Secy. and Treas., G. R. Harmes.

BOWLING GREEN, *Warren Co.* (Pop., 5,114; est., 8 500.) On Barren river at head of navigation, surrounded by hills 5 to 8 miles distant. The surface rock is limestone, but the river rises in a sandstone region, and the water contains little lime. Much of the drainage of the valley flows off through caverns in the subsoil, which is heavy red clay. Has manufactories. Settled in 1787; incorp. a town in 1797.

History.—Built in '68 by town. Des. Engr., Chas. H. Hermany.

Water Supply.—Barren river, pumping to reservoir.

Pumping Machinery—Dy. cap., 2,800,000 galls.; one compound condensing and one high-pressure engine, make not given. The first pump had a 9-in. vertical cylinder of 30-in. stroke.

Reservoir.—Cap., 1,000,000 galls.; is 237 ft. above pumps.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. *Taps*, 780. *Meters*, 28. *Hydrants*, Mathews, 109. *Valves*, Whittier.

Consumption, 350,000 galls. *Pressure*: Ordinary, 77 lbs. Fire, 77 lbs.

Financial.—Cost., $100,000. Debt, $90,000. Int., 6%. Ann, op. exp., $4,000. Ann. rev.: consumers, $12,500: city, none.

Management.—Six Comms. Secy., G. S. Hollingsworth. Supt., Jas. H. Wilkinson. Pumping Engr., Owen Nugent.

COVINGTON, *Kenton Co.* (Pop., 29,700; est.,38,000., On the south bank of the Ohio, at the mouth of the Licking river, opposite Cincinnati, and on nearly level ground. Has manufactories and commerce. Incorp. a village in '15,a city in '34.

History.—Built in '68-70 by city. Des. Engr., Birdsall Holly. Const. Engr., Wm. C. Weir. In '87-9 new works were built by the city, including a very general change in the distributing mains. Consulting Engr., Geo Bouscaren, Cincinnati, O. Resident Eng., A. Petry.

As the new works will not be in operation until the middle of '89, the old works are described first.

OLD WORKS.

Water Supply.—Ohio river, by direct pumping through a 20-in. intake pipe. Water was first taken from a well formed by sinking a wrought iron tube 18 ft. in diam. for 71 ft. through the gravel on the river bank. In the bottom of the well 35 3-in. pipes were driven 12 ft. The pumps were placed on a plate-iron floor 16 ft. above the bottom of the well. The well failed to furnish the necessary amount of water some years ago, and water has since been taken directly from the river.

Pumping Machinery.—Not described for '88. The first pumps were in the well, there being a gang of 12 piston pumps, and two rotaries, driven by two piston and one rotary engine, all furnished by the Holly Mfg Co. The rotary engine and pumps were replaced by a McGowan engine and piston pumps.

Distribution.—*Mains*, 4 to 20-in. c. i., 28 miles. *Services*, lead. *Taps*, about 2,500. *Meters*, none. *Hydrants*, kind not given, 220.

Consumption, in '86, about 1,500,000 galls. *Pressure*: 30 lbs.

Financial.—Cost, $400,000. Debt, $300,000. Int., 7%. Ann. op. exp., $25,000. Ann rev.: consumers, about $30,000; city, none. It should be remembered these figures. are *for the old works*.

Management.—Three Commrs. Secy., N. T. Lindsay. Supt., W. H. Glore. Pumping Engr., Chas. Rensford.

NEW WORKS.

Will be put in operation in '89.

Water Supply.—Ohio river, 8 miles above the city, pumping to two subsiding basins, from which water passes alternately to a distributing basin, and thence by gravity to city, the supply main passing through the suburbs of Newport.

Water is taken from the river about 4,000 ft. above the pump house of the Newport water-works, and nearly a mile above the mouth of the Miami river. The channel at this point is close to the Kentucky shore, the river bank very steep, giving a depth of 12 ft. below extreme low water at a point but 35 ft from the low water shore line. The bottom is of stratified blue shale limestone, and the current prevents deposits at all stages.

Intake Aqueduct.—Of masonry, 4 ft. in diam. and 158 ft. long. The bottom of the aqueduct at the well is 6 ft. below extreme low water, and at the river end, 8 ft., giving a fall of 2 ft. from the well to the river. For about 118 ft. from the well it is in tunnel, and the 40 ft. ending at the river in open cut, protected by a strong pier of ashlar masonry in cement 12 ft. wide and 36 ft. long. The pier is entirely submerged at the lowest stage of water, and the floor of the aqueduct is 5 ft. above the river bottom. The river end is guarded by a wrought iron grating, with bars 2 in. apart. The well end has a 4-ft. gate.

Pump Well.—In engine room, 11 by 77½ ft. at the top, 8 by 75½ ft. at the bottom, and 74½ ft. deep from the engine room floor to the top of the concrete revetment at the bottom, giving 9 ft. of water at extreme low-water.

Pumping Machinery.—Dy. cap., 10,000,000 galls. Two vertical engines, each driving four 1,250,000-gall. pumps arranged to work in pairs, and six horizontal boilers, all furnished by the Holly Mfg. Co. Contract price, $110,000.

Pump House.—The engine room is 50 by 80 ft. in the clear, separated by a partition wall from a boiler room 80 by 40 ft. in the clear, at right angles to the former. The foundations are of stone in cement, carried 15 in. above high-water level for '84. Above this the walls are of brick. The stone is a stratified shale and limestone found from 15 to 20 ft. below the surface.

The roof is of iron carried by wooden trusses. The floor consists of iron-plate girders carrying arches of brick sprung from iron beams, covered with yellow pine in the engine room, and concrete in boiler room. The chimney is of brick on a stone foundation, 6 ft. internal diam., and 100 ft. high above the floor. Contrs., C. J. Limrick, Newport, who also built the masonry foundations for the engines, the pump-well and the aqueduct.

Force Main.—Of 30-in. cast-iron, 3,827 ft. long, the thickness of shell varying with position; 1¼ in. in the first, 1⅛ in the middle, and 1-in. thick in the upper division. The average gradient is about 50 ft. in 100, the highest point in the line being 684 ft. east of the outlet in the north reservoir, 378.1 ft. above water at the pump house, and 12.2 ft. above water-level in the upper basin, when full. There is a tunnel under a turnpike, 37 ft. below the surface. It is through limestone and shale, 300 ft. long, arched with brick, 8 ft. wide and 8 ft. high in the clear. A shaft at the west end of the tunnel gives access to it, and contains the open stand-pipe at the apex of the pipe line. It was estimated that carrying the pipe through the tunnel saves fuel to the amount of about $435 a year for a daily pumpage of 5,000,000 galls.

Dams.—Three, forming reservoirs. Of earth embankments, formed of selected material excavated from the basins, the inner slopes being puddled. The dams are 15 ft. wide on top, with inner slopes of 3 to 1, and outer of 1¾ to 1. The outlet and cleaning pipes of the reservoir pass through stone arched culverts built under the dams into the solid limestone and shale formation, the valve chambers at the inner end being connected with the surface by masonry shafts. The culverts are drained by 8-in. cast-iron pipe.

Reservoir.—Cap., 84,500,000 galls. The distributing basin is formed by damming a branch of Three Mile creek just below a fork in the branch. Partition walls, or dams, on each fork form two subsiding basins. The distributing basin has a cap. of 27,000,000 galls., with water line 5 ft. below top of dam, and 274.8 ft. above high water mark of the Ohio river at Covington in '84. The north subsiding basin has a cap. of 26,500,000, and the south 31,000,000 galls., with water 5 ft. below the partition dams, and 25 ft. above water in the distributing basin.

The areas and depths of water, and capacities of the three basins when full will be approximately;

	Distributing Basin.	N. Basin.	S. Basin.
Water area,	181,335 sq. ft.	209,300 sq. ft.	237,300 sq. ft.
Max. depth,	43 ft.	41½ ft.	41½ ft.
Min. depth,	30 ft.	11 ft.	10½ ft.
Cap. in galls.,	27,000,000,	26,500,000,	31,000,000

It is intended to discharge the water alternately into the subsiding basins, thus giving a constant level in the distributing basin by regulating the inflow. With a daily consumption of 3,000,000 galls. there will be a subsidence of 9 or 10 days in the upper basins, a 9 days' supply in the lower, and a total storage capacity for a 28 days' supply. By drawing the water from the upper to the lower basins, and from the lower basin to the supply main through floating tubes regulated to take water 5 ft. below the surface a still further clarification has been planned.

The piping and valves are designed to connect either one of the upper basins with the supply main, allowing the lower basin to be cleaned or repaired. Arrangements are also made for cleaning or repairing the upper basins.

The inner slopes of each basin are 3 to 1, and the entire surface of the slopes and bottom was to be revetted with concrete, or paving stones in cement. The surface drainage is intercepted by a ditch around each basin, conducting the water into the stream below. Between the ditch and the water there is berme 10 ft. wide which can be used as a walk or drive.

The contract for the reservoir was let to Peter, Scully & Crane, Cincinnati, O., July 15, '87, to be completed Aug. 1, '88. In Dec., '87, this contract was transferred with the consent of all concerned, to S. Casparis & Co., Cincinnati, O. This contract included the placing of all pipes and specials casting in the reservoir, and to and through the tunnel, 684 ft., on the inlet, also about 500 ft. on the outlet.

Supply Main.—Of 30-in. cast-iron for 19,873 ft., of 24-in. for 2,294 ft., and of 20-in. for 3,957 ft., a total of 26,124 ft., or a little less than five miles from the reservoir to the point where it joins the city distribution. About 4,000 ft. from the reservoir the pipe crosses a branch of Three Mile Creek on its bed, and lower, another branch on an 8 ft. arch.

A little over three miles from the reservoir it crosses the Licking river on the bridge of the Elizabethtown, Maysville & Big Sandy R. R., rising vertically at the abutment and being suspended from the underside of the bridge floor, and descending vertically at the other end. The right of way across the bridge cost $20,000.

The 30-in. pipe is 1, 1⅛, and 1¼ in. thick, according to the elevation, and the 24 and 20-in., all 1 in. thick. The difference in elevation between high water surface in the lower basin, and the lowest point in the main in the city is 290 ft., corresponding to a static pressure of 126 lbs., and for the highest point in the main, 230 ft., or a static pressure of 100 lbs. For a daily consumption of 5,000,000 the loss of head by friction will not exceed 11 lbs. at the highest point on the main in the city, which will leave a working pressure of 89 lbs.

All pipes and special castings for the new works were furnished by the Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and these were laid by McRae & Lally, Detroit, Mich., with the exception of those parts in and about the reservoir. The valves were furnished by the Eddy Valve Co., Waterford, N. Y.

Management and Cost.—The new works were built under the direction of the Board of Trustees of the Covington Reservoir: Alex. Davezac, Jas. O'Hara, Jno. E. Hamilton, Amos Shinkle, who was Prest., and Jas. Spillman, Secy. Consulting Engr., Geo. Bouscaren, Cincinnati, O. Resident Const. Engr., A. Petry.

To the end of '87 the estimated cost of material and labor contracted for was $810,900, and the total cost, $979,000. This was distributed: for pipe and castings, $199,808; for delivering and distributing same, $15,426; for laying same, $65,060; for reservoir and pipes about it, $317,390; pump house and aqueduct, $91,709; engines and boilers, $110,000; valves, gates, curbs and hydrants, $10,607. The most of the balance of the estimated cost was for right of way, 4 per cent. for contingencies and 6 per cent. for engineering and general expenses, reckoned on total cost of other items.

FRANKFORT, *Franklin Co.* (Pop., 6,958; est., 8,250.) On the Kentucky river, 29 miles from Lexington, and on an elevated plane between the river and a bluff rising 150 ft. The river is in a deep limestone channel. Manufactures lumber whiskey and twine. Incorp. in 1786.

OLD WORKS.

General Description.—Built in '41 by town, after plans by James Judge, taking the supply from a spring, by gravity.

The spring is 33 ft. above and 2½ miles from the town, and in '82 a 6-in. pipe led from it to a distributing reservoir of stone masonry, 30 by 80 ft., by 6 ft. deep. A stone dam was built ¾ miles from the spring to form a storage reservoir, and a 12-in. pipe laid from it to the town. The dam was 200 ft. long, 35 ft. high, 10 ft. wide at the bottom and 3 ft. at the top. It leaked too badly for use, and the pipe was so poorly laid that it was never brought into service. Distribution was by 4 and 3-in. cast-iron pipe; there were no fire hydrants, 8 gates, 500 taps, and the services were of lead and iron.

PRESENT WORKS.

History.—Built in '84-6 by Frankfort Water Co., under a perpetual charter. Engr., Chas. Hermany, Louisville.

Water Supply.—Kentucky river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; compound single-acting vertical plunger Holly-Gaskill pump, and tubular boilers.

Reservoir.—Cap., 5,000,000 galls. when filled to a depth of 16 ft.; in two compartments, each 116 by 140 ft. at bottom. Contrs., W. F. Shanks and J. Jamison, Louisville.

Ditribution.—*Mains*, c. i., 12 miles. *Services*, galv. i., lead. Pipe and specials furnished by Dennis Long & Co. Louisville. *Taps*, 500. *Meters*, 5. *Hydrants*, Mathews, 100. *Valves*, Whittier.

Consumption, 700,000 galls. *Pressure*: Ordinary, 125 lbs. Fire, 125 lbs.

Financial.—Cost, $175,000. Capital stock, $150,000. Bonded debt, $125,000. Int., 5%. Ann. op. exp., $7,301. Ann. rev.: consumers, $10,000; city, $6,250. Hydrant rental, $6,250.

Management.—Prest., Saml. A. Miller. Secy., W. Reinecke, Louisville, Ky. Supt., Jno. D. Griffin.

HENDERSON, *Henderson Co.* (Pop., 5,365; est., 10,000.) On east bank of Ohio river on gently undulating ground. Manufactures cotton and woolen goods, flour, whiskey and tobacco. Settled in 1797; incorp. a town in '10, a city in '67.

History—Built in '74-6 by city. Des. Engr., Thos. J. Whitman. Const. Engr., Gaston M. Alves.

Pump-Well.—Is 8 by 15 ft., by 39 ft. deep, with stone walls 9 ft. thick at the bottom and battered on the outside to 4 ft. at the top.

Water Supply.—Ohio river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 3,500,000 galls. The first pump had a cap. of 1,500,000 galls., was made by Gerald, Allen & Co., and consisted of a beam and fly-wheel engine with 20-in. steam cylinder, and two single-acting plunger pumps of 14½-in. bore, all of 60-in. stroke. The second pump is a Gordon & Maxwell, added since '82.

Reservoir.—Cap., 3,000,000 galls.; in excavation and embankment with inner slopes 1½ to 1, and outer, 1¾ to 1. Is 70 ft. above business part of city, and 148 above bottom of pump-well. The inner slopes are covered with 2 ft. of puddle and paved with 9 in. of hard brick in cement mortar. The bottom is covered with 18 in. of puddle, above which is 5 in. of concrete made of broken bats and cement mortar. The excavation at the bottom of the reservoir was in sand, and the puddle was placed upon this. At first there was considerable leakage, but after four months this greatly diminished.

Stand-Pipe.—On bank of reservoir, 5 ft. in diam. and 80 ft. high.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, galv. i. *Taps*, 783. *Meters*, 10. *Hydrants*, Bailey, Mathews, 69. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $150,000. Debt, $113,000. Int., 5 and 6%. Ann. op. exp., $4,500 Ann. rev.: consumers, $11,000; city, none.

Management.—Commrs. Chairman. I. F. Mayer. Secy. and Treas., Fred Kleiderer. Supt., Pumping Engr., Jas. P. Wigal.

LEBANON, *Marion Co*, (Pop., 2,054; est., 3,000.)

History.—Built in '88 by city. Engr., J. D. Cook, Toledo, O. Contrs., Scovel & Irwin Construction Co., Nashville, Tenn.

Water Supply,—Rolling Fork Creek, pumping either from a filter gallery, or direct from the stream, at will, to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; duplex compound pump made by Gordon Steam Pump Co. Boilers furnished by Union Iron Works, Chattanooga, Tenn.

Force Main.—Of 8-in. c. i., 8,500 ft. long, rising about 480 ft.

Reservoir.—Cap., 1,000,000 galls.; of earth and stone.

Supply Main.—Of 10-in. cast-iron, 12,500 ft. long.

Distribution.—*Mains*, c. i., about 8 miles. Furnished by Dennis Long & Co., Louisville. *Hydrants* and *Valves* furnished by Bourbon Copper & Brass Works, Cincinnati, O.

Financial.—Cost, est., $52,250. Bonded debt, $60,000.

Management.—Supt., Jno. Rutel. Report by Jno. M. Knott,

Works were not finished at time of report.

LEXINGTON, *Fayette Co.* (Pop., 16,656; est., 26,000.) On north branch of James river, on irregular ground. Has manufactories. Settled in 1735; incorp. in 1778.

OLD WORKS.

General Description.—Built in '32 by city, taking water from springs collected in a reservoir 25 ft. in diam. and 15 ft. deep, holding 55,080 galls. The reservoir was 265 ft. above the river, and 62 ft. above the highest point on Main street. At the end of '82 there were three miles of 3-in. cast-iron distributing mains, 9 hydrants and 400 taps.

PRESENT WORKS.

History.—Built in '84 by Lexington Hydraulic & Mfg. Co. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., S. A. Charles, the present Supt. Contr. for masonry and buildings, L. B. Stevens, Toledo, O.

Water Supply.—Surface water, by direct pumping from impounding reservoir

Reservoir.—Covers 40 acres. Contrs., C. A. Mason & Co.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 17½ miles. *Services*, lead. Pipe and specials furnished and laid by M. Philbin, Chicago, Ill. *Taps*, 464. *Meters*, 199. *Hydrants*, Holly. 232. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost. withhheld. Capital stock, $250,000. Bonded debt. $233,000; 208,000 at 6, and $25,000 at 7%. Ann. op. exp., $8,000. Ann. rev.; consumers, $12,000; city, $11,600. Hydrant rental, $50, hydrants to be set not more than 300 ft. apart.

Management.—Prest., C. G. Hildreth, 45 Broadway, New York City. Supt. and Treas., S. A. Charles. Pumping Engr., F. A. Cramer.

LOUISVILLE, *Jefferson Co.* (Pop., 123,758; est., 165,000.) On south bank of Ohio river, on an elevated plateau 70 feet above low water in the river. Settled in 775; incorp. a city in '41.

History.—Built in '57-60 by Louisville Water Co., the city owning the greater part of the stock. The company was chartered in '54, and Sept. 6, '56, the city was authorized by a popular vote of 1,415 to 370 to subscribe for $550,000 of the company's stock, and to issue bonds to that amount. In '77 a large storage reservoir was built, and in '88-9 a new pumping station is being constructed. The Engr. of the works to '61 was Theo. R. Scowden, and since '61 Chas. Hermany has been Chf. Engr. and Supt.

Water Supply.—Ohio river, pumping to reservoir, stand-pipe and direct. Water is taken from the river 1.52 miles above the city limits, the shore at this point being of sand and coarse gravel.

Intake Pipe.—Of wrought iron, 50 in. in diam. and 300 ft. long, set in a timber crib filled in with stone. The mouth is 5 by 12 ft., and is 1 ft. below extreme low water.

In '65 this pipe was half filled with silt, which in '66 gave so much trouble that a well was sunk over it, 105 ft. from the end, the intention being to clean it. High water stopped work till '67, when the pipe was cleaned. Its outside was sound, but there were tubercles on the inside, the deepest corrosion being 1-16 in. In Dec., '70, anchor ice stopped the pumps, and the strainer had to be removed temporarily, and in '74 floating leaves caused another stoppage.

In '77 the pipe was again cleaned, 20 in. of silt having accumulated. This time the top of the inside of the pipe was found to be corroded in some places be a depth of ¼ in.

Pumping Machinery.-Dy, cap., 21,000,000 galls.: Cornish beam engines and boilers driving Blake pumps. A large additional pumping plant was contracted for in '88.

Stand-Pipe.—Of ½ to ¼-in. plate-iron, 4 ft. in diam. and 132 ft. high above the ground, which is 41 ft. above low water in the river. A wooden tower enclosed the stand-pipe. An attempt to pump directly to the mains, in '70, resulted in a ram which broke a 30-in. main. In '75 an arrangement was made by which water from the stand-pipe overflowed into four 20 in. pipes instead of feeding the mains from its base. This enabled water to pass into the distribution mains without passing through the reservoir.

Old Reservoir.—Cap., 10,000,000 galls.: has water surface 178 by 374 ft., is 19.4 ft. deep and 141 ft. above low water in the river. A dividing wall 12 ft. high was built, through which the force main rose to 144 ft. above low water, discharging through a bell mouth. In '69 a second force main was laid to a chamber from which it discharged over a weir, 10 ft. long. The bottom of the reservoir is paved with two courses of brick in cement, laid flat, and the slopes with one course, on edge, a 9-in. inverted brick arch connecting the bottom and slope pavements.

Breaks.—In '62 the outer slopes slid, and 1⅜-in. sheet piling was driven at right angles to them. In '70 two springs about 900 ft. from the reservoir had increased in volume with an increase of pumpage, without filling the reservoir. A leak w found over the pipe laid beneath the bottom of the reservoir and the pipe was encased with concrete.

In June, '76, leaks appeared at the base of the bluff on which the reservoir stands and an irregular rupture was found in the reservoir bottom through which water escaped following the rock surface below. A pit 3¼ ft. in diam. and 9 ft. deep was dug, puddled, and filled with concrete.

Cleaning the Reservoir.—In '76 sediment had accumulated to a depth of 5 ft. making a total deposit of 11,000 cu. yds. To remove this an 18-in. L was placed in the end of the 20-in. drain pipe the end of the L being turned up in the drain-well, and secured. A hopper was attached to this, and a stream of water under a head of 28 to 52 ft. kept playing into it at the same time the deposit being wheeled to the hopper and thrown in. To loosen the deposit for shoveling a ¾-in. stream of water was thrown through a 3-in. linen hose. After beginning to remove the deposit 41 men worked 139 consecutive hours to clean the north basin, and after changing to the south, 52 men worked 100 hours to clean it.

Crescent Hill Reservoir.—Cap., 100,000,000 galls. Begun in Apr., '77, and water was admitted Dec. 15, '79. It is 2½ miles from the stand-pipe and 175 ft. above low water in the river. The reservoir was built with great care, but leaks and slips occurred soon after it was filled.

Distribution.—*Mains*, c. i., 137.4 miles. Since '68 all pipe has been coated with Angus Smith's preparation. *Services*, galv. i., lead. *Taps*, 11,001. *Meters*, 678; these were first put in use in '62. *Hydrants*, 147. *Cisterns*, 437.

Consumption, 10,307,056. *Pressure*: Ordinary, 35 lbs. Fire, 50 lbs.

Financial.—Cost, $5,008,809. Capital stock, $1,275,100. Bonded debt, $900,000. Int., 6%. Ann. op. exp., $59,258. Ann. rev.: consumers, $256,556; city, none.

Management.—Directors, Chf. Engr. and Gen. Supt., Chas. Hermany.

MAYSVILLE, *Mason Co.* (Pop., 5,220; est., 8,000.) On Ohio river, in uneven country. Has manufactories. Settled in 1785; incorp. a city in '25.

History.—Built in '80 by private company. Des. Engr., Travers Daniel.

Water Supply.—Ohio river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake pumps, one with 16, and one with 19¾-in. cylinders, of 36-in. stroke, lifting water against a head of 418 ft. The pumps are in a well 15 ft. in diam. and 50 ft. deep.

Reservoir.—Cap., 3,000,000 galls.; in two basins, 425 ft. above low water in the river.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead, galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville. *Taps*, 612. *Meters*, 50. *Hydrants*, Mathews, 51. *Valves*, Eddy.

Consumption, 200,000 galls. *Pressure*: average, 155 lbs.

Financial.—Cost, $200,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $12,000; city, nothing, it having paid $50,000 for perpetual fire protection when the works were constructed.

Management.—Prest., Jacob Toreger. Secy., A. R. Cooper, Louisville, Ky. Supt. and Pumping Engr., August Schaeffer.

NEWPORT, *Campbell Co.* (Pop., 20,443; est., 27,500.) On south bank of Ohio river, opposite Cincinnati, O., and separated from Covington by the Licking river on the west. Has large pipe and other manufactories. Settled in 1791.

History.—Built in '72 by city when the population was about 16,000. Engr., Theodore R. Scowden.

Water Supply.—Ohio river, at a point 4 miles above the city, by pumping to reservoir.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; one 1,000,000 gall. Cope & Maxwell, and two 2,000,000-gall. vertical Holly-Gaskill pumps.

Force Main.—For the first 1,445 ft. it rises 350 ft., and is of 20-in. cast-iron. From the crest of the bluff the pipe changes to 24 in. for 250 ft., then to 20 in. for 4,318 ft., in which distance it falls 56 ft., finally discharging into the reservoir.

Reservoir.—Cap., 45,000,000 galls. Formed by an earth dam across the junction of two ravines, and is divided by an embankment 16 ft. high. The main dam is 35 ft. high, with stone paving on the slope. The water surface is 8 acres. The surrounding surface drainage is carried beneath the reservoir in 24-in. pipes, meeting in a 36-in. pipe which passes under the dam with stone collars 8 ft. sq. and 2 ft.

thick, every 12 ft. Two 30-in. effluent pipes were laid through the dam, connecting with the 20-in. supply main in the city.

June 17, '75, the north basin was rapidly emptied, and the slopes slid in. On examination half the drain pipes were found broken. They were stopped up, surface drains made, and the banks repaired. Later the inner slope of the main embankment fell in, and the paving has not yet been removed from the bottom of the reservoir. The effluent pipes were laid in a fill which was only partially settled, the result being leakage. The reservoir cannot be emptied without drawing all the water through the city, nor can it be cleaned save at great expense. The main embankment was built to hold 30 ft. of water, but as the division embankment is but 16 ft. high the reservoir cannot be filled without doing away with a clear water basin. On account of the broken embankment and the leaky effluent pipes it is not considered safe to store more than 16 ft. of water in either basin.

Steps were taken in '88 to put the reservoir in shape, the first contracts being for changing the effluent pipes.

Distribution.—*Mains*, c.i., 26.6 miles. *Services*, lead. *Taps*, 3,256. *Meters*, Worthington and Crown, 76. *Hydrants*, Bourbon Copper & Brass Works, 155. *Valves*, Cummings, Eddy, Bourbon Copper & Brass Works.

Consumption, 900,000. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $760,962. Bonded debt, $800,000. Int., 7.3%. Total cost of maintenance to Dec. 31, '87, $167,823. Total revenue, $353,499. Ann. op. exp., for '87, $9,916. Ann. rev.: total for '87, $38,877, of which $33,037 was from water rates. No allowance made for fire hydrants.

Management.—Four Trustees. Engr. and Supt., B. R. Morton. Mech. Engr., Geo. Cronimus.

OWENSBOROUGH, *Daviess Co.* (Pop., 6,231, est., 11,500.) On the Ohio river. Has large and numerous tobacco and whiskey manufactories, and woodworking shops. Settled in '16: incorp. a city in '66.

History.—Built in '79 by Owensboro Water Co.

Water Supply.—Ohio river, by direct pumping.

Pumping Machinery.—Dy. cap., not given. At first there were two Holly-Gaskill pumps of 25-in. steam, 14-in. water cylinders, and 28-in. stroke. In '88 a 2,500,000-gall. pump was added.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i., lead. *Taps*, 600. *Meters*, 30. *Hydrants*, Holly, 126.

Consumption, 550,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 125 lbs.

Financial.—Cost, withheld. Capital stock, in '82, $80,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, in '86, $4,500; city, $6,300.

Management.—Prest., Dennis Long. V. Prest., Jno. G. Barret. Gen. Mgr., Saml. A. Miller, Louisville. Secy., Wm. Reinecke. Supt. and Pumping Engr., Henry P. Martin.

PADUCAH, *McCracken Co.* (Pop., 8,036; est., 18,000.) At junction of Ohio and Tennessee rivers. Has manufactories, and a large river and tobacco trade.

History.—Built in '86 by Paducah Water Supply Co. of Baltimore, Md., and sold Mar. 1, '88, to Paducah Water Co., of Paducah. The latter company was chartered by the Legislature Feb. 20, '88. The franchise is for 20 years. Engr., E. F. Fuller. Contr., Saml. R. Bullock & Co., both of New York City.

Water Supply.—Ohio river, by pumping through stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; one Holly-Gaskill pumping engine, and one upright, high-pressure engine.

Stand-Pipe.—Is 22 ft. in diam. and 175 ft. high.

Distribution.—*Mains*, c. i., 13 miles. *Services*, not given. *Taps*, 620. *Meters*, 2. *Hydrants*, Pattee & Draper, 163. *Valves*, kind, do.

Consumption, 280,000 galls. *Pressure*: Ordinary, 60 lbs. average. Fire, 200 lbs.

Financial.—Cost, $182,000. Capital stock, $150,000. Bonded debt, $150,000. Int., not given. Ann. op. exp., including taxes, $6,400. Ann. rev.: consumers, $11,670; city, $6,330. Hydrant rental, $40 for first 150, $30 for next 30, and $25 for all additional.

Management.—Prest., Henry Burnett. Secy., L. M. Rieke. Supt. and Treas., Muscoe Burnett.

PINEVILLE, *Bell Co.* (Pop., est., 1,200.) Engaged in iron and coal mining.

History.—Built in '88 by Pineville Water Co. Engr., Emil Mahlo. Contr., Jno.

Cosgrove, Pineville. The works were begun Oct. 1, '88, and were to be put in operation Jan. 1, '89. Franchise is perpetual.

Water Supply.—Bird's branch, by gravity to distributing reservoir.

Reservoir.—Cap., about 150,000 galls.; 35 by 40 ft., by 15 ft. deep.

Distribution.—*Mains*, 4 to 8-in. c. i., 5 miles. *Hydrants*, Mathews, 20. *Valves*, Ludlow. Other data not determined.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 80 lbs.

Financial.—Cost, $25,000. Capital stock, $12,500. Bonded debt, $12,500. Int., 6%. Ann. op. exp., est., $200. Ann. rev.: consumers, $1,200; city, $300. Hydrant rental, 15, a three years' contract.

Management.—Prest., F. A. Hull, Danbury, Conn. V.Prest. and Gen. Mgr., J.S. Ray. Secy., D. N. Mason.

PLEASANT HILL, *Mercer Co.* (Pop., est., 200.) In blue-grass region.

History.—Built in '33 by "United Society of Shakers," and now known as the works of the Mercer Water Co. The system supplies "four large families" with water. The four families consist of 200 persons.

Water Supply.—Spring, pumping to tank. The spring has a daily flow of 5,500 galls.

Pumping Machinery.—Old fashioned force pump, with 5-in. discharge, made in '33, and worked by one or two horses. It raises water 120 ft.

Tank.—Wooden, cap., 4,482 galls.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, lead. *Taps*, 15. *Meters*, none. *Hydrants*, none.

Consumption, 4,000 galls. *Pressure*: head of 120 ft.

Financial.—Cost, $1,500. No debt. Ann. op. exp., $150. No revenue.

Management.—Supt., Jno. A. Van.

Water-Works Projected with Fair Prospects of Construction.

CENTRAL CITY, *Muhlenberg Co.* (Pop., est., 1,500.) Engaged in coal mining and manufacturing.

Proposed System.—The Central City Water Co. propose to build works in '89, pumping water from Green river to stand-pipe. Est. cost, $30,000 to $40,000. The coal and railroad companies are interested. Address T. C. Dupont.

HARRODSBURGH, *Mercer Co.* (Pop., 2,002; est., 4,000.) Is 8 miles from Frankfort.

Proposed System.—To pump from river, 1½ miles from center of town, to stand-pipe. Est. cost, $50,000 to $60,000.

The Harrodsburgh Water Co. was to be organized to build the works in '88, but to Nov. nothing had been done. E. H. Gautier is at the head of the project.

NICHOLASVILLE, *Jessamine Co.* (Pop., est., 3,000.) Has some manufactories.

Proposed System.—Address J. S. Bronaugh, Mayor.

PARIS, *Bourbon Co.* (Pop., 3,204; est., 5,000.) Manufactures tobacco and whiskey.

Proposed System.—A contract for works was granted in '88, but Contr. failed to comply. Water to be pumped from stream to stand-pipe, and the town to pay not more than $3,000 hydrant rental. Chairman Water-Works Board, W. P. Chambers.

RICHMOND, *Madison Co.* (Pop., 2,909; est., 4,000.) In agricultural district.

Proposed System.—A charter for works has been granted and prospects are said to be good. Address F. H. Adair.

Water-Works Projects Reported in '87 and '88, but Now !

Ashland, *Boyd Co.*; Georgetown, *Scott Co.*; Guthrie, *Todd Co.*; Jeffersonville, *Montgomery Co.*

GROUP 5.—Central Northern States.—Water-Works Completed, in Process of Construction or Projected, in Ohio, Indiana, Michigan, Illinois and Wisconsin.

OHIO.

Water-Works Completed or in Process of Construction.

AKRON, *Summit Co.* (Pop., 16,512; est., 30,000.) On height of land between Lake Erie and Ohio river, 495 ft. above the lake, and 1,065 above the sea. Manufactures matches, flour, crackers, sewer-pipe, pottery and agricultural implements, Settled in '25.

History.—Built in '80-1 by Akron Water-Works Co., under a perpetual charter. Engr., Joseph Flannery. Contrs., M. S. Frost & Son.

Water Supply.—Well in gravel, pumping to reservoir. The well is of brick, 50 ft. in diam. and 32 ft. deep, with walls from 30 to 18 in. thick sunk on a cast-iron shoe by excavating from the inside and letting their weight carry them down.

Pump House.—Of brick and artificial stone finished inside with oak. The engine room and boiler room are each 30 by 40 ft., and the coal room 28 by 30 ft. The chimney is 95 ft. high, 11 ft. sq. at the base at 6 at the top. Architect, F. O. Weary, Akron.

Pumping Machinery.—Dy. cap., 1,500,000 galls,: Worthington pump.

Force Main.—Originally 2,500 ft. of 16-in. cast-iron.

Reservoir.—Is 200 by 250 ft., by 15 ft. deep.; in excavation and embankment, lined with 18 in. of puddle, on which is a paving of sand-stone blocks in cement.

Distribution.—*Mains*, c. i., 25 miles. *Services*, galv. i. Pipe furnished by Lake Shore Foundry Co., Cleveland, and specials by Taplin, Rice & Co., Akron. *Taps*, 1,520, *Meters*, 60. *Hydrants*, Mathews, 187. *Valves*, Chapman.

Consumption, 1,500,000 galls. *Pressure*: 60 to 90 lbs.

Financial.—Cost, $250,000. Capital stock, $250,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.; consumers, $28,000; city, 9,500. Hydrant rental, $45.

Management.—Prest., Frank Adams. Secy., H. C. Starr. Supt. and Pumping Engr., E. A. Lawton.

ALLIANCE, *Stark Co.* (Pop., 4,635; est., 6,130.) On Mahoning river on rolling ground. Engaged in manufacturing. Settled in '33 as Freedom; incorp. as Alliance in '75.

History.—Built in '83 by Alliance Water-Works Co. Contrs., J. A. Cloud, Philadelphia, Pa.

Water Supply.—Mahoning river, pumping to stand-pipe and direct.

Dam.—Of squared timber cribs, filled in with stone, and forming a pool from which water is pumped.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall Worthington pumps. Boilers made by Cunningham Iron Works, Boston, Mass.

Stand-Pipe.—Is 20 ft. in diam. and 80 ft. high; furnished by Cunningham Iron Works, Boston, Mass.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. *Taps*, 271. *Meters*, 25. *Hydrants*, Coffin, 55. *Valves*, Coffin.

Consumption, 193,291 galls. *Pressure*: Ordinary, 73 lbs. Fire, 100 to 140 lbs.

Financial.—Cost, $145,000. Capital stock, $75,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $3,360. Hydrant rental, $60.

Management.—Prest., Daniel Runkle. Secy. and Treas., Wm. Runkle, 160 Broadway. Supt. and Pumping Engr., J. C. Reed.

ASHTABULA, *Ashtabula Co.* (Pop., 4,445; est., 6,200.) On Ashtabula river, 3 miles from Lake Erie. Engaged in manufacturing, and in coal and iron business.

History.—Built in '87 by Ashtabula Water-Works Co., under a 20 years' franchise Des. Engr., S. H. Lockett, N. Y. City. Const. Engr., E. J. Snow, the present Supt. Contrs., Comegys & Lewis, New York City. Sub. Contrs., for masonry, Russell and Washburne; for buildings, Russell & Bawker. Both of Ashtabula.

Water Supply.—A series of wells and tubes on the sandy shore of Lake Erie, pumping to stand-pipe.

Pumping Machinery.—Dy. cap.,3,000,000 galls.; two Worthington pumps and two 150 H. P. Hazleton boilers.

Stand Pipe.—Is 20 ft. in diam. and 100 ft. high; furnished by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, lead, iron. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky. Trenching and pipe-laying done by the Water Co. *Taps*, 160. *Meters*, 2. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs.

Financial.—Cost, $130,000, Capital stocks and bonds, $150,000. Int., 6%. Ann. op. exp., not determined. Ann. rev.: consumers, $8,000, including railways; city, $4,500. Hydrant rental, $45.

Management.—Prest., Henry Fassett. Secy., J. Morgan. Supt., E. J. Snow.

ATHENS ASYLUM FOR THE INSANE, *Athens Co.* (Pop., 900.) At Athens, on the Hocking river.

History.—Built in '73-4 by the asylum. Des. Engr., Dean Stickney.

Water Supply.—Well, pumping to reservoir. The well is 26 ft. in diam. and 20 ft. deep, in gravel, 600 ft. from Hocking river.

Pumping Machinery.—Two Deane pumps, dy. cap., 1,000,000 galls.

Reservoir.—Cap., about 400,000 galls.; 50 by 150 ft., by 6 ft.deep, in excavation and embankment, 150 ft. above the pumps and 100 ft. above the Asylum.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, c. i. *Taps*, not given. *Meters*, none. *Hydrants*, Chapman, 5. *Valves*, Chapman.

Consumption, 125,000 galls. *Pressure*: 35 lbs.

Financial.—Cost, unknown. No debt or revenue. Ann. op. exp., not given.

Management.—Supt. of Asylum, A. B. Richardson.

AVONDALE, *Cincinnati P. O., Hamilton Co.* (Pop., est., 4,500.) A suburb of Cincinnati, with an area of 1¾ sq. m.

General Description.—Pipe laid in '87, and owned by the village. The city of Cincinnati furnishes water from its tank on Mount Auburn, controls the system, collects all rates, and after 20 years, or earlier, is to own the distribution system to the amount of $75,000, provided that 50% of the revenue derived from the same be returned to the village for that purpose.

Address Arthur G. Moore, Supt. and Engr., Cincinnati Water-Works.

BELLAIRE, *Belmont Co.* (Pop., 8,025; est., 12,000.) On Ohio river, 5 miles south of Wheeling, W. Va. Engaged in mining coal and manufacturing.

History.—Built in '72 by city. Engr., Jos. L. Lowry, Pittsburgh, Pa.

Water Supply.—Ohio river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 4,000,000 galls. Pump No. 1 was furnished by J. L. Lowry, and No. 2 by Epping, Carpenter & Co. Both of Pittsburgh.

Reservoir.—Cap., 3,000,000 galls.: semi-circular, 190 ft. by 95 ft., one mile from and 216 ft. above the pumps, and 165 ft. above the main part of the city. Has puddled banks and a 4-in. brick lining.

Distribution.—*Mains*, c. i., Wyckoff wood, 9½ miles. *Services*, lead. *Taps*, 1,143. *Meters*, 6. *Hydrants*, Lowry, Mathews, 77. *Valves*, Lowry.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $130,000. Debt, $130,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $2,300; total, $17,000.

Management.—Supt. and Secy., H. G. Wilson. Pumping Engr., Jno. Kuckade.

BELLEFONTAINE, *Logan Co.* (Pop., 3,998; est., 5,000.) In farming district.

History.—Built in '83 by town.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 11,000,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i., lead. *Taps*, 150. *Meters*, 3. *Hydrants*, Mathews, 72.

Consumption, 500,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, $2,000: city, none.

Management.—Secy., I. N. Zearing. Supt., C. F. Martin.

BELLEVUE, *Huron Co.* (Pop., est., 2,169: 3,500.) On slightly rolling ground between the prairie and a swamp. Has railway repair shops and manufactories. Settled in '15; incorp. a city in '51.

History.—Built in '73 by city. Engr., —— McReynolds, Cleveland.

Water Supply.—Surface water, collected in a reservoir by a ditch draining a large area of prairie, then pumped to a stand-pipe.

Reservoir.—Cap., about 200,000,000 galls.; in excavation and embankment, covering 12 acres. Is on same level as city.

Pumping Machinery.—Dy. cap., 1,080,000 galls.; two Knowles pumps.

Stand-Pipe.—Not described.

Distribution.—*Mains*, Wyckoff wood, 2.3 miles. *Services*, w. i. *Taps*, about 100. *Meters*, none. *Hydrants*, kind not given, 19.

Consumption, 1,000,000 galls. *Pressure*; Ordinary, 18 lbs. Fire, 18 lbs.

Financial.—Cost, $38,000. Debt, $36,000. Int., 5, 6 and 8%. Ann. op. exp., $965. Ann. rev.: consumers, about $2,500, of which $1,450 is from the railways.

Management.—Three Trustees. Supt., Jno. L. Painter.

BROOKLYN, *Cuyahoga Co.* (Pop., 1,295; est., 3,500.) On Cuyahoga river, 3 miles south of Cleveland.

History.—Built in '88 by village. Contrs., L. B. Stanley, Collinwood, and D. B. Fish, Brooklyn Village.

Water Supply.—Cleveland Water-Works, through meter.

Distribution.—*Mains*, 4 to 8-in. c. i., 2½ miles. *Services*, kind not given. Pipe and specials furnished by Lake Shore Foundry Co., Cleveland. *Taps*, 90. *Meters*, Worthington, 47. *Hydrants*, Ludlow, 24. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $14,000. Debt, $8,000. Int., 6%. Other data not determined.

Management.—Secy., H. M. Farnsworth, 219 Superior St., Cleveland.

BUCYRUS, *Crawford Co.* (Pop., 3,835; est., 7,000.) On Sandusky river, on quite level land. Has railway shops. Settled in '22; incorp. a city in '33.

History.—Built in '83-4 by private company, name not given. Engr., —— Salnio. The franchise is for 30 years. Contrs., Michigan Pipe Co., Bay City, Mich.

Water Supply.—Well, by direct pumping. The well is 50 ft. in diam., 20 ft. deep, and is walled with cut stone.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two pumps made by M. Walker having 14-in. steam and 18½-in. water cylinders of 12-in. stroke.

Distribution.—*Mains*, Wyckoff wood, 12 miles. *Services*, lead, iron, Wyckoff wood. *Taps*, 218. *Meters*, none. *Hydrants*, Holly, 101 public and 1 private. *Valves* Galvin.

Consumption, 207,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $60,000. Capital stock, $20,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $3,240. Ann. rev.: consumers, $3,000; city, $5,140. Hydrant rental, $55.71 for first 70, and $40 for each additional.

Management.—Prest., J. B. Gormly. Secy. and Treas., G. P. Smith. Supt., Dorsey B. Smith.

CANTON, *Stark Co.* (Pop., 12,258; est., 25,000.) On Nimishillen creek on quite level ground. Manufactures agricultural implements, steel saws, safes, pocket cutlery, wrought-iron bridges, woolen goods, glass-ware and pottery. Settled in '06, and has been incorp. a city.

History.—Built in '69 by city. Engr., J. L. Pillsbury.

Water Supply.—Myers' lake and Nimishillen creek, by direct pumping. The first supply was from the lake, which is 2½ miles from the city. This becoming inadequate, water was taken from the creek, which is now the principal source of supply.

The lake has an area of 150 acres, and a drainage area of about 13 sq. m. The creek rises 5 miles above the pumping station and drains a gravelly country.

Conduit.—Extends from lake to pumps, 1½ miles of 24-in. earthenware pipe.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; one 2,000,000 and one 3,000,000-gall. compound duplex pump. A small Cameron pump has been used.

Distribution.—*Mains*, c. i., 20 miles. Wrought-iron and cement pipe was first used, but was unsatisfactory. *Services*, galv. i. *Taps*, 1,430. *Meters*, 3. *Hydrants* Holly, Mathews, Galvin. *Pressure gauge*, Edson.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Debt, $140,000. Int., 5%. Ann. op. exp., $7,000. Ann. rev.: consumers, $14,500; city, none.

Management.—Three Trustees. Secy., Paul Field. Supt., Louis B. Ohlinger.

CHILLICOTHE, *Ross Co.* (Pop., 10,938; est., 12,600.) On Scioto river. Has various manufactories.

History.-Built in '81-2 by Chillicothe Gas Light & Water Co. Const. Engr., W. F. Inman. Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Well on bank of Scioto river, pumping to reservoir.

Pumping Machinery—Dy. cap., 3,500,000 galls.; 1,500,000 and 2,000,000-gall. Worthington pumps.

Reservoir.—Cap., 3,500,000 galls.

Distribution.—*Mains*, c. i., 22 miles. *Services*, galv. i., lead. Sub-Contrs. for pipe and specials, Cincinnati & Newport Iron and Pipe Co. *Taps*, 800. *Meters*, Crown Empire, Worthington, 20. *Hydrants*, Mathews, 100. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Hydrant rental, $60. All other data withheld.

Management.—Prest., Wm. Poland. Secy. and Treas., A. C. Kopp. Supt., F. A. Stacey.

CINCINNATI, *Hamilton Co.* (Pop., 255,139; est., 275,000.) On north bank o Ohio river, covering about 24 sq. m. A plain 60 to 100 ft. above low water in the river extends for some distance back from the river, beyond which the ground rises rapidly to an elevation of 400 ft. Has large manufacturing and commercia interests. Founded in 1789; incorp. a city in '19.

History.—Built in '20 by Saml. W. Davis who organized the Cincinnati Water Co. in '26. Bought by the city June 15, '39, and extended by it from time to time since. An improvement or change of the supply is now under consideration. The suburban villages of Avondale and Clifton own 17 miles of pipe and are supplied from Cincinnati. The city controls their supply and collects all revenues, and in 20 years, or earlier, is to own the pipe in Avondale to the amount of $75,000, and in Clifton to the amount of $25,000, provided one-half of all revenues collected are refunded for this purpose.

When the works were built in '20 the population was 9,642. The capital stock of the company at the time of its organization was $75,000. When the city purchased the works there had been laid 117,813 ft., or 22.3 miles, of wooden logs, with a bore from 1½ to 2½ in., and 20,243 ft., or nearly 4 miles of iron pipe, mostly 3 and 4 in. in diam. All mains laid since then have been of cast-iron.

Water Supply.—Ohio river, pumping to reservoirs for low and middle service, and pumping to tank for high service. The drainage area of the river above Cincinnati is about 77,000 sq. m., of which 8,000 sq. m. near the city furnishes water containing salts of lime.

The hardness of the supply varies with the amount furnished by limestone basin. The supply is subject to contamination, water being taken from the river about ¾ miles from the center of the city, and 5 miles from its upper limits. For a time the eddy from Deer creek canal caused much pollution, but this was temporarily stopped by sinking barges, and permanently by extending the intake pipes and changing the shore line.

The supply introduced by Saml. W. Davis in '20 was pumped by horse-power from the river to a tank, and then repumped by horse-power to a wooden distributing reservoir.

Intake-Pipes and Aqueducts.—In '81 water was taken from the river near the channel, about 100 ft. from the river front of the pump-house, and conducted through iron pipes and stone aqueducts to the pump-wells. In low water the principal supply was furnished to the pumps through two 40-in. pipes. These were laid on the bed of the river, extending 40 ft. from the stone walls forming the outer limits of the aqueduct.

There are two aqueducts, one 5 and the other 20 ft. wide. In the large aqueduct a 60-in. wrought-iron pipe was laid for an independent supply to the large engine, but owing to the irregular operation of this the pipe became packed with river deposit. The height of the river varies 60 ft. and the suction pipes of the pumps are placed below low water.

Pumping Machinery.—Dy. cap., 73,000,000 galls.

The first pumps were of wood, driven by horse-power there being one to lift the water from the river to a tank, and another to pump it to the reservoir. In '24 the first steam pumping was introduced, Mr. Davis buying the engines and boilers of the old steamboat Vesta. The engine had a 12-in. cylinder and 60-in. stroke, with a wooden beam. At each end of the beam were two pumps, one set lifting water from the river to a tank on the engine house floor, and the other forcing it from the tank to the reservoir. All the pumps had 6-in. bore and 48-in. stroke. This engine was remodelled in '28 and abandoned in '44.

In '32 a second pumping engine was built. The engine was upright, direct-acting, with a fly-wheel, and a 25-in. cylinder of 96-in. stroke. This engine drove a 17-in. double-acting plunger pump, placed below it. The force main was 20-in. in diam. This engine was used until '64.

In '46 another high-pressure pumping engine, designed by Geo. Shield, was built. It had 23-in. horizontal cylinders of 120-in. stroke, working a fly-wheel connected to the crank of which was a double-acting vertical plunger pump of 14-in. bore and 120-in. stroke. To '81, this engine had been in constant use since its construction, first pumping into a reservoir against a head of 165 ft., and since '75 against 224 ft. head.

In '81 it was called one of the most economical engines connected with the works. Steam was cut off at ⅝ stroke. In '47 the pump was temporarily stopped by high water, which rose above the steam cylinders. In '51 the engine house floor was raised to about 2 ft. above the high water mark in '47.

In '51 a condensing engine and pump, designed by T. R. Scowden, was built. It had an upright steam cylinder 45-in. in diam., of 96-in. stroke. The 18-in. double-acting plunger pump was placed below the steam-cylinders, and a fly-wheel is driven by a connecting rod from the piston rod. In '54 a duplicate of the latter engine was built, and in '79 its pump cylinder was bored to a diam. of 18½ in. In '81 these pumping engines were used exclusively for the low service, working against 165 ft. head.

In '65 a condensing pumping engine was built. It was designed by Geo. Shields, and had a 100-in. steam cylinder of 144-in. stroke, vertical, with a 46½ double-acting plunger pump below. Prior to '74 this engine could not be run faster than five double strokes a minute, and the ram was so great that the force main was burst five times. A change was made in the pump-valves in '74, and since then it has been possible to run at nine strokes a minute. In '79 the addition of 75 ft. to the working head improved its performance. The force main from this engine is of wrought-iron, ½ in. thick, and 50 in. in diam.

In '72-4 two duplex non-condensing pumping engines were erected after designs by T. R. Scowden. They have 28-in. steam cylinders of 96-in. stroke, working pumps with buckets of 23½-in., and plungers of 16½-in. diam.

In '69 pumps for the high-service were built from plans by A. G. Moore, the present Engr. and Supt. The first was a duplex non-condensing engine with 18-in. steam cylinders of 60-in. stroke, and pumps of 9-in. bore, enlarged in '74 to 11 in., and in '79 to 13½ in.

In '79 a compound pump, designed by A. Warden, was added to the high-service station. It has a 14-in. high, and a 22½-in. low-pressure steam cylinder, and 10-in. pumps, all of 30-in. stroke.

There has recently been added pumping machinery of 25,000,000 galls. capacity.

General Description of Reservoirs.—The first was of wood, built in '20. In '51 the city built a low service reservoir, and in '66 it began the Eden Park middle-service reservoir, finishing the upper basin in '75 and the lower in '78.

Low Service Reservoir.—Cap., 5,000,000 galls.; on Third street, 750 ft. from the engine house and 165 ft. above it. It is rectangular, in two divisions, has dressed stone walls, and is entirely above the surface of the ground. Its flow-line is 170 ft. above low water in the river: the lowest point supplied is about 60, and the highest 100 ft. above low water. In '81 about one-third of the water consumed was supplied from this reservoir.

Eden Park Middle Service Reservoir.—Cap., 1,000,000 galls. In a deep rapidly descending ravine, and is formed by a retaining wall or dam, and divided by a wall into an upper basin of 57,000,000, and a lower basin of 43,000,000 galls. capacity. The flow-line of this reservoir is 232 ft. above low water in the river. The lowest point supplied is 60, and the highest 180 ft. above low water. Two 35-in. supply mains led from the reservoir in '81, and the high-service supply is repumped from here.

The dam is 119 ft. high, 48½ ft. wide at its base, 25.8 ft. at the bottom of the reservoir, and 22 ft. at the top. Its extreme length is 1,251 ft. Eight elliptical arches, 55 ft. long with 18-ft. rise, are constructed along the outer face of the dam to support part of a roadway. The arches, copings and pilasters are finished with dressed Dayton stone.

The southwestern part of the lower basin is of filled ground, 85 ft. in depth. The division wall is 30 ft. wide at base, 10 at top, and 400 ft. long, including effluent and influent chambers, the former being at the west and the latter at the east end.

The effluent pipes from the reservoir are laid in a tunnel, 12 ft. in diam., 1,160 ft. long, of four courses of brick in cement, costing $73,000. The reservoir cost $1,660,000.

High-Service Tanks.—These receive water that is repumped from the Eden Park reservoir for supplying the higher districts. The first tank was built in '69, on Mt. Auburn, and in '70 a second one was built for the same service. Each is 60 ft. in diam, and 38 ft. high, made of plates 50 by 144 in., from $\frac{11}{16}$ to $\frac{7}{16}$ in. thick. The vertical joints are double riveted, and the bottom plates are ¼-in. thick.

In '81 another tank was completed on Price's Hill. It was 40 ft. in diam., 100 ft. high, had a cap. of 2,700,000 galls., and was placed on a solid masonry foundation. It was of steel, ½-in. thick at the bottom and ¼-in. at the top. When nearly full for the first time the tank gave way at the bottom and was ruined. It is stated that the construction was not in accordance with the specifications. It was designed by Jas. E. Bell, then Supt., and the Contrs. were Geo. Stacey & Co., Cincinnati. It is not stated whether this tank has been rebuilt.

Distribution.—*Mains*, c. i., 247 miles. *Services*, lead. *Taps*, 31,128. *Meters*, 1,280; first used in '60. *Hydrants*, made by city. *Valves*, also made by city. *Hrdraulic elevators*, 635. *Pressure gauge* Edson.

Consumption, 32,079,445 galls. *Pressure*: Extremely variable, and not relied upon for fire protection.

Financial.—Cost, $7,847,895. Debt, $1,370,000. Int., 6, 7 and 7 3-10%. Ann. op. exp., $273,564. Ann. rev.: consumers, $638,176; city, none.

Management.—Secy., Richard E. Zeidler, Supt. and Engr., Authur G. Moore.

References.—A more detailed account of the Eden Park Reservoir, by Jno. W. Hill, Cincinnati, is given in Trans. Am. Soc. C. E., vol. XVI., pp. 261-72.

In *Engineering News*, vol. V., p. 204, some additional historical matter may be found, and in the same journal, vol. VIII., pp. 278-80, is an extended account of the bursting of the high service tank on Price's hill.

CIRCLEVILLE, *Pickaway Co.* (Pop., 6,046; est., 10,000.) On Scioto river, 25 miles from Columbus. The river furnishes water-power used in manufacturing. The city is on the site of an old circular fortification, hence its name.

History.—Built in '86-7 by Circleville Water Supply Co., under a 20 years' franchise. Engr., E. F. Fuller. Contr., Saml. R. Bullock. Both of New York City.

Water Supply.—Darby creek, pumping from filter gallery on the shore to stand-pipe.

Storage Reservoir.—Cap., 14,000,000 galls.

Filter Gallery.—Not described.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound condensing Holly-Gaskill pumps.

Distribution.—*Mains*, 6 to 16 in. c. i., 11½ miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 140. *Meters*, not given. *Hydrants*, Ludlow, 100. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: not given.

Financial.—Cost, $180,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,100; city, $3,500. Hydrant rental, $35.

Management.—Prest., E. Woltmann, Treas., N. P. Hobart, Secy., D. W. Duryea. Supt., Wm. Deane.

CLEVELAND, *Cuyahoga Co.* (Pop., 160,146; est., 230,000.) On Lake Erie and both sides of the Cuyahoga river, the valley of which is but little above the lake. On each side the ground rises to an elevation of 128 ft. Engaged in commerce, manufacturing and ship-building. Settled about 1796.

History.—Built in '54 6 by city when the population was about 25,000. The building of the first system took from '53 to '58, a temporary intake being used meanwhile. From '69 to '74 important extensions were made, including a lake tunnel, and in '88 contracts were let for a new and larger tunnel. Prior to '67 T. R. Scowden was Engr. and since then J. Whitelaw has filled that position.

The Cleveland Water Co. was organized in '33, had its privileges extended, and its capital stock increased to $200,000 in '50, but never did any work.

The village of West Cleveland is supplied from these works through two meters being treated as a single customer. See West Cleveland.

Water Supply.—Lake Erie, pumping to reservoirs.

Old Intake.—This consisted of an intake crib and pipe, and a brick conduit ending in the pump-well. The intake crib was 300 ft. from the shore, formed by driving two piles abreast in two concentric circles, with a space of 6 ft. between the two rings. The water at this point was 12 ft. deep, the piles were driven as far as possible, then the space between the rings filled with stones, and the piles capped with timber. The inside diam. was 10, and the extreme outside, 30 ft. Water was admitted to the intake pipe through an iron grating and chamber, the former being 4 ft. below the water surface. The pipe was of ⅜-in. boiler plate, 50 in. in diam., 300 ft. long and at the shore connected with an oviform brick aqueduct ending in the pump-well, 3,550 ft. distant. The horizontal diam. of the aqueduct was 4 ft., and the vertical, 5 ft. The ring was 8 in. thick, of hard burned brick laid in hydraulic mortar.

The water near the shore becoming polluted with drainage, from '69-74 a new intake crib was sunk in the lake and connected with the aqueduct at the shore by a tunnel.

Second Intake Crib.—Built of 12-in. white pine, 61 ft. high, pentagonal, each outer side measuring 54, and each inner, 19 ft. Midway between the two walls is a second wall. Both sides of each wall are covered with 2-in. oak plank, the three walls are tied together and braced, and each wall has drift bolts running through the courses of timber. The spaces between the middle, inner and outer walls are filled with stone to the under side of the floor, or deck, which is 12 ft. above the lake surface, except that for 5 ft. below low water the space between the middle and inner wall was filled with concrete, which serves as a foundation for a stone superstructure built on the crib in '78. About 400 cords of stone were placed around the crib. Before the crib was completed it had settled 14 ft. into the clay, but has stood well since.

Water is admitted to the well-hole of the crib through two large openings near the bottom of the lake, each large enough to supply water to the full capacity of the tunnel. From these openings gate wells extend to the top of the crib. For 5 ft. down from a little above high water the outside of the crib is plated on three exposed sides with ½ in. boiler iron, and on the two shore sides with ⅜-in. This was done to prevent thin ice from cutting the timber, as during the first winter grooves 1 in. deep were cut in this way. The Contrs. for the crib were D. D. & A. H. D. Delameter.

Tunnel.—The total length from lake to shore shaft, following curves, is 6,661.6 ft., and in a straight line, 6,006 ft. The diam. of the tunnel is 5 ft.

In '75 the tunnel was extended from the shore 2,580 ft. to the pump wells the new part having diameters of 5½ and 6 ft. Previous to this the old aqueduct had been used.

The internal diam. of each shaft is 8 ft., and their depth below water surface is, for the lake shaft, 90.2 ft., for the shore, 67½ ft. The inlet shaft from the floor of the crib to the top of the tunnel is of iron, 46 ft. of the lower portion being of 2-in. cast-iron, put together in six sections, each 7 ft. 8 in. long. The four upper sections are of ⅜-in. boiler iron, with cast-iron flanges. All of the sections are bolted together. When water was admitted two of the upper sections were removed, the water flowing in over the top, 9 ft. below the surface, thus giving a greater intake area than would have been secured by using gates at the sides. This tends to prevent the accumulation of anchor ice about the inlet.

In the construction of the tunnel, many difficulties were encountered, chiefly from soft clay, sand, gas and water. Work was begun at the shore end, and here the shaft passed through 20 ft. of quicksand. Iron cylinders were used and the work successfully done. From the bottom of this shaft there was an irruption of water and inflammable gas, causing delay, but this was shut out after the bottom was covered with masonry.

In the tunnel the first great difficulty was a break in the clay, through which gas, water and quicksand poured, necessitating the building of a bulkhead as near the break as possible. Before this could be done 300 ft. of the tunnel had filled with sand, and had to be abandoned. The length of tunnel saved was 1,300 ft. A deflection of 20 degrees to the west was made by an easy curve, and the tunnel continued parallel to and 40 ft. from the original line. Apr. 9, '71, when nearly 4,000 ft. from the shore the workmen heard a noise behind them like escaping steam. Rushing toward the shore for 600 ft, they found water coming through the masonry in fine streams for a distance of 150 ft. For a week 8,000, and afterwards 6,000 barrels of water were pumped out each day. Hoping the leak would finally cease the shore section was abandoned for the time and work begun at the lake end.

At 380 ft. from the lake shaft soft clay began to run in faster than it could be removed and the masonry built. As the rising grade was about 1 ft. in 100 the flow was facilitated.

The working end was bricked up until a shield was built to keep the clay in place. This was made of heavy boiler iron, braced with two cast-iron rings 4 in. sq. in radial section. The shield was 6 ft. long and had an internal diam. of 6½ ft., being just large enough to build a section of the brick-work of the tunnel inside it. Usually about 16 in. of brick-work was built at once, always leaving 8-in. of the finished tunnel within the shield. With all this care cracks appeared for 30 ft. in the softest of the clay. They were all cross-wise, at the junction of two sections. At each crack cast-iron rings 12 in. wide and 1 in. thick, put together in segments, and keyed up tight, were set in the brick-work in cement mortar.

The shield was used for about 140 ft. in the length of the tunnel. At first it was moved forward by 12 large screws, but later hydraulic presses with an aggregate power of 135 tons were substituted, and these were hardly sufficient to move the shield.

It was impossible to push the shield forward in line, it working to the left two degrees, 46 minutes, and a little downward. The pressure on the shield was about four tons to the square foot, which broke the cast-iron rings in several places, and flattened the cylinder about 4 in.

After removing the shield good progress was made until the lake section was within 20 ft. of the shore section, when an explosion threw a large mass of clay from the face of the excavation, throwing down the workmen and putting out their lights. Gas and water poured in, driving out the workmen. As the lake section filled the water in the shore section became lower, so that pumping from either one lowered both. The gas gave much trouble, but this and other obstacles were overcome and the two sections joined. On clearing out the shore section it was found that a part of the tunnel had settled bodily, 5 ft., having broken off in short lengths An attempt was made to rebuild this part, but new cracks appeared. Serious leaks occurring some distance from the part which had settled, and the tunnel at that point filling rapidly with sand, gas and water two bulkheads were erected 832 ft. apart, outside of this and the settled portion and a new piece of tunnel was built parallel to, 73 ft. west of, and connected with the main line. These and the other connecting curves were lined with a thin coating of cement mortar, making he surface smooth, and lessening friction.

In '75 the tunnel was extended from the shore to the pump-wells, 2,580 ft., to take the place of the old aqueduct, the diameters being 5½ and 6 ft. The bottom of the extension is 10-in. lower than the main tunnel at the shore end, and 74 ft. below the surface of Old River St.

The tunnel and its extension was driven through unstratified blue clay, some portions being dry and hard, others moist and soft. In this were stone varying in size from 4 cu. ft. to gravel. The distance from the lake surface to the rock under the clay is 80 ft. at the shore shaft, and 117 ft. at the crib. The rock is a soft, light-colored shale.

The Contr. for the tunnel was A. A. McDonnel, and for the extension, Jos A. McDonnel, brother of the former, they being associated in both jobs. The Engr of the tunnel was Jno. Whitelaw, and during the early part of the work T. R. Scowden was Consulting Engr.

New Tunnel.—From inlet crib to main pumping station, 7 ft. in diam., 9,200 ft. long, and with an est. dy. cap. of 110,000,000 galls. a day, giving a head of 13½ ft. on the suction pipes. The contract was let, Mar. 24, '88, to I. S. Casement, Painesville, O., for $201,301. The capacity of the two tunnels will be 150,000,000 galls.

Foundations of Pumping Station.—On quicksand, there being two courses of 12-in. timbers, 1 ft. apart, with the spaces filled with concrete. On this a flooring of large stones was laid, then inverted arches built to support walls of the engine foundation and the pump-well. The timbers extended beneath the whole station, and under the stand-pipe.

Pumping Machinery.—Dy. cap., 70,000,000 galls. The first pumps had a capacity of 7,500,000 galls, and consisted of a pair of Cornish beam engines, exact duplicates, with 70-in. steam cylinders and 120-in. stroke, driving 30-in. pumps of 105-in. stroke. The beams were coupled, and the double beam was 29 ft. 10½ in. between end centers, 6⅜ ft. wide at the fulcrum, and with the center shaft weighed 40 tons. The arms of the beam were unequal, the longer end connecting with the steam cylinder, and being 15 ft., 11 in., while the end connected with the pumps was 13 ft., 11½ in. The displacement for each stroke of the pump was nearly 321 galls., and the maximum speed, pumping against a head of 166 ft. in the stand-pipe, was 11½ strokes, or 100 ft. per minute when but one engine was run. The boilers were of the Cornish type, 6 by 30 ft. The best duty shown by these engines was about 50,000,000. They delivered water to the reservoir through the stand-pipe and a 24-in. main 2,200 ft. long.

The Cornish engines pumped all the supply for 18 years.

New 10,000,000-gall. pumps of Knowles and Worthington make were added, one each, in '74, '76, '82 and '84, and in '88 two 15,000,000-gall. Knowles pumps were put in operation.

Stand-Pipe.—At the engine house, 36 ft. in diam. and 148 ft. high.

Force Main.—The first was 24-in. in diam. and 2,200 ft. long, leading to the old reservoir. With the new engines new mains were added, and for the supply east of the river there are now one 16, one 20, and two 30-in. mains, while a 30-in. main supplies the part of the city west of the river, the crossing being by three wrought iron pipes, one 36 and two 33 in. in diam. All are ½ in. thick, double riveted, from 220 to 270 ft. long, dipping by easy curves 25 ft. below water surface, and lying in trenches.

Old Reservoir.—Cap., 6,000,000 galls. In embankment 21 ft. high, lined with 2 ft. of puddle, and paved with brick in cement.

Fairmount Low Service Reservoir.—Cap., 80,000,000 galls., there being two distinct basins conforming to the topography, one holding 47,000,000, and one 33,000,000 galls. The head of water is 170 ft. above Lake Erie. The land for this reservoir was bought in '82.

High Service Reservoir.—Cap., about 38,000,000 galls. It is 325 ft. above Lake Erie, and is filled from the Fairmount reservoir. The old Cornish engines were removed from the main to the high-service station. The force main between the two reservoirs is 30 in. in diam. and 13,000 ft. long. About a year after its completion the water was drawn out to within 2 ft. of the bottom. There was considerable ice in the reservoir, and this together with the drawing out of the water, caused the banks and pavings to slide in, damaging a quarter of the paving, or less. The embankments were of clay, and it is claimed that they had not fully settled.

Distribution.—*Mains*, c. i., 252 miles. *Services*, galv. i., lead. *Taps*, 22,658. *Meters*, 1,525. *Hydrants*, kind not given, 2,517. *Stop gates*, about 5,000.

Consumption, 22,206,155 galls. *Pressure*: 12 to 70 lbs.

Financial.—Cost, $5,053,091. Debt, $1,775,000. Int., 3½ and 7%. Ann. op. exp., $89,916. Ann. rev.: consumers, $394,154; city, none.

Management.—Prest. of Trustees, S. W. Sessions. Secy., W. A. Madison. Supt. and Engr., J. Whitelaw.

References.—An interesting historical and descriptive sketch of these works was given by Jno. Whitelaw, the Engr. and Supt., at the Eighth Annual Meeting of the American Water-Works Association, Cleveland, O., Apr. 19, '88. Discussion followed. This is given in Report of Proceedings of the Convention.

An article on "The Water Supply of Cleveland, its Sanitary and Chemical Qualities," was read before the Civil Engrs. Club of Cleveland, Nov. 11, '84, and published in the Journal of the Association of Engineering Societies, vol. IV., pp. 284-9.

The following references are to *Engineering News*:

"The Cleveland Water Supply," vol. VI., pp. 132, 140, 148 and 185. Gives a very detailed account of the works from their start to the end of '87, describing at length the construction of the first tunnel and accompanying improvements. An article on the sliding in of the high service reservoir banks is given in vol. XVI., p. 422.

CLIFTON, *Hamilton Co.* (Pop., est., 1,200.) A suburb of Cincinnati, having an area of 1¼ sq. m.

General Description.—Water was supplied from the Cincinnati water-works in '86. The village owns the pipe, but the contract with the city provides for the entire control of the works and collection of the revenue, the pipe system to be owned by the city after 20 years, or earlier, to the amount of $25,000, provided one-half of all revenues collected by the city be returned to the village semi-annually for that purpose.

For further particulars address A. G. Moore, Supt. and Engr, Cincinnati water Works.

CLYDE, *Sandusky Co.* (Pop., 2,380; est., 3,000.) Is 17 miles from Sandusky and 38 from Toledo. Has various manufactories.

History.—Built in '83-4 by city. In '86 the pipe system was extended and a settling reservoir built. Engr., J. D, Cook, Toledo, O.

Water Supply.—Artesian wells, by direct pumping, with Raccoon creek for a reserve.

Storage Reservoir.—On creek, and largely of natural formation.

Settling Basin.—Built in '86.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. Gordon & Maxwell pumps, one being a compound condensing low-pressure, and the other a high-pressure pump.

Distribution.—*Mains*, c. i., 4.2 miles. *Services*, galv. i. *Taps*, 140. *Meters*, none. *Hydrants*, Bailey, 38. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, $25,000. Debt, $28,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.; consumers, $1,000; city, none.

Management.—Secy. and Supt., Chas. H. Eaton.

COLUMBUS, *Franklin Co.* (Pop., 51,647; est., 95,000.) On Scioto river, close by the great iron and coal fields of the State. The site is nearly level. Has extensive trade and manufactories. Settled in '12.

History.—Built in '70 by the city when the population was 31,274, the previous supply having been from wells.

Water Supply.—Ground water from filter galleries near the Olentangy and Scioto rivers, by direct pumping.

Filtering Basins and Galleries.—The first supply was from a well on the bank of the Olentangy river, a tributary of the Scioto. In '73-4 filtering basins were built close to the Olentangy river, and a conduit built between these and the old well. The lower basin was excavated to 27 ft. below the ground, or 13 below the river surface. It had slopes of 1 to 1, protected by riprap,and a bottom area of 14,994 sq.ft. Its supply was from ground water and the upper basin. The latter had a surface area of 8,742 sq. ft., and was excavated 7 ft. below the river.

On the river side of the upper basin, 7 ft. below the surface, a gallery 18 by 21 in. was built, emptying into the lower basin. From it 14 smaller galleries extended under the upper basin, the bottom of which was covered with graduated gravel and sand, the coarsest gravel being at the bottom and there being 7 in. of fine sand at the top. A 12-in. pipe admitted water from the river to this basin, covering the sand with 2½ ft. of water at low stages of the river. The filter was too small, it receiving 1,000,000 galls., of which it filtered but one-half

In '77-9 a natural filter gallery was extended along the river bank from the pumps. The conduit is elliptical, 36 by 42 in., of specially moulded arch brick, each alternate course in the lower half having openings to admit ground water, where the conduit passes through good gravel. The conduit is generally 23 ft. below the surface, or 10 ft. below low water in the river. It was constructed in open cut, hrough strata of alluvial deposit, quicksand and gravel. It is 5,715 ft. long, passing beneath the Olentangy river and terminating at a bend in the Scioto, where a well with gates and inlet pipes allows water to be drawn from the river, if necessary.

In '85 the gallery was extended, or a new one built, but no official data of this has been furnished.

Pumping Machinery.—Dy. cap., 18,000,000 galls.; Holly-Gaskill pumps, flue and tubular boilers.

The first pumping machinery was a four cylinder engine driving gang and rotary pumps. In '74 an engine and four 12-in. pumps were erected, having a nominal cap. of 6,000,000 galls. when working under 60 lbs. water pressure. In '76 the old gang and rotary pumps were removed and a four-cylinder, double-acting pump of 12-in. bore and 27-in. stroke substituted, the pumps being geared to a shaft driven by the engine of the old pumps.

Scioto River Crossing.—By a 10-in. wrought iron pipe, 426 ft. long, having ball and socket joints. In '73 an ice gorge broke the pipe in the middle section, and the whole length was relaid in a trench 30 in. deep, dredged in the river bottom.

Distribution.—*Mains*, c. i., w. i., 70.2 miles. *Services*, galv. i. *Taps*, 5,207. *Meters*, 480. *Hydrants*, Holly, Bailey, 565. *Valves*, Holly, Eddy. *Pressure gauge*, Edson.

Consumption, 5,846,081 galls. *Pressure*: Ordinary, 70 lbs. Fire, 120 lbs.

Financial.—Cost, $1,160,175. Debt, $772,000. Int., 4 and 6%. To Mar. 31, '80, the cost of the works, including interest and repairs, had been $884,867, and the total receipts, $291,048. For the year '80 the receipts from water rents were $44,572, and the cost of maintenance was $19,045. For '87:—Ann. op. exp., $30,919. Ann. rev.: consumers, $101,434; city, none.

Management.—Three Trustees. Supt., A. H. McAlpine.

CRESTLINE, *Crawford Co.* (Pop., 2,848; est., 3,000.) On rolling ground Has railroad shops, and manufactories. Settled in '50; incorp. a city in '55.

History.—Built in '69-70 by city. Des. Engr., H. W. McDonnell. Const. Engr., Geo. C. Morgan, Chicago, Ill. Work done by the city.

Water Supply.—Springs, by gravity from collecting reservoir.

Reservoir.—Cap., about 1,500,000 galls.; of earth and stone, 120 by 280 ft., by 8 ft. deep, and 127 ft. above city.

Distribution.—*Mains*, Wyckoff wood, 9 miles. *Services*, galv. i. *Taps*, 155. *Meters*, 1. *Hydrants*, Holly-Gaskill, 31. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure*: Ordinary, 52 lbs. Fire, 52 lbs.

Financial.—Cost, $85,000. Debt, $25,000. Int., 5%. Ann. op. exp., $600. Ann. rev.: consumers, $2,300; city, none.

Management.—Three trustees. Prest., Jos. Zeller. Secy., Adam Hoffman, Treas., Jno. J. Kirkland.

DAYTON, *Montgomery Co.* (Pop., 38,678; est., 55,000.) At junction of Mad and Great Miami rivers, on a level plain. Has large car works and other manufactories. Settled in 1796: incorp. a city in '41.

History.—Built in '69-70 by city. Consulting Engr., Wm. C. Weir.

Water Supply.—From 30 8-in. tube wells, by direct pumping, the water flowing to a well near the pump house. The average depth of the wells is 40 ft., they are on both sides of Mad river, connected to a 20-in. pipe crossing the river, and water is brought across the river from the main connecting pipe through a 20-in. pipe.

The first supply was from a well 20 ft. in diam., sunk 300 ft. from Mad river, and carried down lower than the river bed. A conduit 100 ft. long connected it with a trench 15 by 108 ft., by 18 ft. deep. The well and trench were both covered. This source yielded about 500,000 galls. a day, and the supply being inadequate in '73 three lines of 20-in. pipe were laid to Mad river. The ends of the pipe were supported on a revetment wall of masonry 15 ft. high and 50 ft. long. Boulders were piled against the wall to serve as a strainer, and inside the wall the pipes were supported on stone. The water from this source had a brownish color, a strong taste and odor.

In '75-6 a second well was dug, 18 ft. in diam. and 30 ft. deep. It yielded about 500,000 galls. a day, and recourse to the river was still necessary. As the river takes the drainage of a thickly settled valley its water is very impure, and in '80-1 a filter gallery was built, rectangular, 4 ft. wide and 8 ft. high. It had dry stone side walls, was covered with flat stone and had a plank flooring, 26 ft. below the surface of the ground.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; one 4,000,000 and one 3,000,000-gall. Holly-Gaskill pump.

At first there were two elliptical rotary pumps of 2,000,000 galls. cap., and a 3,000,000-gall. set of gang pumps. In '80 these pumps were removed, and four piston pumps substituted, the old engine being retained. In '73-4 a 4,000,000-gall. pump was added, having four steam cylinders of 18-in. diam., and 12-in. pumps, all of 30-in. stroke.

Distribution.—*Mains*, c. i., 37 miles. *Services*, lead. *Taps*, 1,799. *Meters*, 96. *Hydrants*, Holly, Cummings, 326. *Pressure gauge*, Edson.

Consumption, 1,851,015 galls. *Pressure*: Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Total cost and expenditures to Dec. 31, '87, $979,459. Total income to Dec. 31, '87, $338,322. Bonded debt, $602,000: $552,000 at 4%, and $47,000 at 6%. Ann. op. exp., $19,000. Ann. rev.: consumers, $28,430; city, none.

Management.—Three Trustees, Secy., Chas. A. Herbig. No Supt., Chf. Pumping Engr., Martin L. Weaver.

DEFIANCE, *Defiance Co.* (Pop., 5,907; est., 8,500.) At confluence of Maumee and Auglaize rivers. Engaged in trade and manufacturing.

History.—Built in '87-8 by Defiance Water Co., under 30 years' franchise. Engr., Ellis Morrison. Contr., Saml. R. Bullock. Both of New York City.

Water Supply.—Maumee river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two compound condensing pumps, make not given.

Stand-Pipe.—Is 22 ft. in diam. and 140 ft. high.

Distribution.—*Mains*, c. i., 12.8 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky.

Financial.—Cost, not given. Capital stock, $200,000. Bonds, $200,000. Int., 6%.

Management.—Prest., Denton W. Duryea. Secy. and Treas., E. F. Fuller.

NOTE:—Not finished at time of report.

DELAWARE, *Delaware Co.* (Pop., 6,895; est., 9,000.) On Olentangy river, 25 miles from Columbus. Manufactures woolen goods, agricultural implements, chairs, iron fences, carriages and cigars.

History.—Being built in '88-9 by Moffett, Hodgkins & Clarke, Watertown, N. Y., who are the Engrs. and Contrs. The local name is the Delaware Water Co. Work was begun Nov. 1, '88, and will be finished in about a year.

Water Supply.—Wells and springs, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls.

Stand-Pipe.—Is 20 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, c. i., about 17 miles. *Hydrants*, 206.

Financial.—Hydrant rental, $6,800 for 206.

Management.—Prest., J. F. Moffett. V. Prest., H. C. Hodgkins. Treas., Frank Watts. Secy., H. N. P. Dole.

NOTE:—Other data not determined.

DENNISON, *Tuscarawas Co.* (Pop., est., 2,300.) Has railway car and machine shops.

History.—Built in '88. Contrs., McCormick & Moran. No other data given in time for insertion. Report by Contrs.

EAST LIVERPOOL, *Columbiana Co.* (Pop., 5,568; est., 7,500.) On Ohio river, 44 miles from Pittsburgh. Has extensive pottery manufactories. Settled about 1800; incorp. a village in '34.

History.—Built in '79 by village. Des. Engr., R. C. Phillips.

Water Supply.—Ohio river, pumping to reservoir, and direct if desired.

Pumping Machinery.—Dy. cap., not given; two 10-in. Cope & Maxwell plunger pumps.

Reservoir.—Cap., 2,500,000 galls.; 266 ft. above city.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, (in '82,) 700. *Meters*, (in '82), 3. *Hydrants*, (in '82,), 75.

Consumption, (in '82,) 200,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 160 lbs.

Financial.—(In '82,) Cost, $40,000. Debt, not given. Ann. op. exp., $5,000. Ann. rev.: consumers, $7,000.

Management.—Secy., N. N. Searles.

NOTE:—No report has been given since '82.

ELYRIA, *Lorain Co.* (Pop., 4,777; est., 5,500.) At junction of East and West branches of Black river, 25 miles from Cleveland. Manufactures shears, screws and other goods.

History.—Built in '79 by Elyria Gas & Water Co.

Water Supply.—Black river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington pump, and steel boilers.

Tank.—Is 34 ft. in diam. and 20 ft. high.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. *Taps*, 350. *Meters*, none. *Hydrants*, Mathews, 55. *Valves*, Ludlow.

Consumption, 450,000 galls. *Pressure*: Ordinary, 34 lbs. Fire, 100 lbs.

Financial.—Cost, $150,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., $3,681. Ann. rev.: consumers, $6,000; city, $5,000. Hydrant rental, $85, a five year's contract.

Management.—Prest., Geo H. Ely. Supt, Secy. and Treas., D. M. Clark.

FINDLAY, *Hancock Co.* (Pop., 4.633; est., 20,000.) On Blanchard's fork of Auglaize river, in natural gas fields. Manufactures glass, furniture and nails, and refines oil.

History.—Built in '88-9 by city. Engr., Jno. W. Hill. Cincinnati. Contrs. for foundations and buildings, Cassidy & Murray, Cincinnati.

Water Supply.—Blanchard river, pumping direct.

Dam.—Of masonry, forming storage or impounding reservoir. Contrs., Houston & Freeman, Cincinnati.

Storage Reservoir.—Cap., 86,000,000 galls. Contrs., Freeman & Houston.

Filter Galleries.—Contrs., W. H. Campfield & Co.

Pumping Machinery.—Dy. cap., 2,500,000 galls.: two compound duplex direct-acting Gordon & Maxwell pumps.

Distribution.—*Mains*, 4 to 20-in. c. i., 18 miles: furnished by Addyston Pipe & Steel Co., Addyston. Trenching and pipe-laying done by Jas. J. Rumsey, Canton. *Hydrants*, Bourbon, 139. *Valves*, Eddy.

Financial.—Cost, $250,000. Bonded debt, $250,000. Int., 5%.

Management.—Three Trustees: B. F. Kimmons, Prest., Wm. Edwards and P. B. Morrison.

NOTE:—Not finished at time of report.

FRANKLIN, *Warren Co.* (Pop., 2,385; est., 3,500.) On Great Miami river, 16 miles north of Dayton. Manufactures paper and agricultural implements.

History.—Built in '87-8 by town. Engr., Jno. W. Hill, Cincinnati. Contr. for masonry and buildings, J. D. Hendrickson, Franklin.

Water Supply.—Six 6-in. driven wells, 64 ft. deep, connected with 6, 8 and 12-in. pipe, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. compound duplex direct-acting Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead. Pipe and specials furnished by New Philadelphia, (O.,) Pipe Works, and trenching and pipe-laying done by Snyder & Williams, Dayton. *Taps*, 50. *Meters*, not given. *Hydrants*, Mathews, 60. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $45,000. Bonded debt, $45,000,000. Int., 5%. Ann. op. exp., and rev., not determined.

Management.—Trustees: C. W. Anderson, Wm. Michaels and N. W. Earhart.

FREMONT, *Sandusky Co.* (Pop., 8,446; est., 10,000.) On Sandusky river at head of navigation, 24 miles from Sandusky, and 30 from Toledo.

History.—Built in '82-3 by city. Engr., J. D. Cook, Toledo, O.

Water Supply.—Mainly from springs, pumping from storage reservoir to stand-pipe.

Reservoir.—Cap., about 2,500,000 galls.; 100 by 200 ft., by 15 ft. deep. Is within city limits, near Sandusky river.

Pumping Machinery.—Dy. cap., 4,000,000 galls.: a 3,000,000-gall. compound condensing, and a 1,000,000-gall. high pressure Knowles pump; two tubular steel boilers 5½ by 16 ft.

Tank.—Of Otis steel, 25 ft. in diam, and 100 ft. high. Located on a hill near center of distribution, ½ mile from the pumps and 50 ft. above center of city.

Distribution.—*Mains*, c. i., 11 miles. *Services*, galv. i., lead. *Taps*, 300. *Meters*, *Hydrants*, Mathews, Lowry, 110. *Valves*, Ludlow.

Consumption, 275,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 90 lbs.

Financial.—Cost, $140,000. Debt, $135,000. Int., 5%. Ann. op. exp., $3,699. Ann. rev.: consumers, $5,217; city, none.

Management.—Trustees. Supt., Chas F. Reiff.

GALION, *Crawford Co.* (Pop., 5,635; est., 7,000.) Engaged in manufacturing.

History.—Built in '82-4 by Galion Water-Works Co., under a 30 years' franchise. No Des. Engr. Const. Engr., Saml. C. Starr.

Water Supply.—Wells, 30 ft. in diam. and 28 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Deane pumps, and Root boiler.

Stand-Pipe.—Is 6 ft. in diam. and 140 ft. high; made by Tippett's Sons, Harrisburg, Pa.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 95.

Consumption, 350,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 80 lbs.

Financial.—Cost, $100,000. Capital stock, $100,000. Bonds, $70,000. Int., 6%. Ann. op exp., $300,000. Ann. rev.: consumers, $3,000; city, $5.000. Hydrant rental, $60, $50, and $35, according to number, which is not given.

Management.—Prest., J. H. Green. Secy. and Treas., O. L. Hays. No Supt.

GRANVILLE, *Licking Co.* (Pop., 1,127; est., 1,500.) Is 6 miles west of Newark, and 25 east of Columbus.

History.—Built in '85 by town.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., 400,000 galls.: Knowles compound duplex pump, and 50 H. P. horizontal tubular boiler.

Tank.—Cap., 95,000 galls.; 20 by 30 ft.

Distribution.—*Mains*, c. i., w. i., 4½ miles. *Services*, galv. i., black i. *Taps*, 110. *Meters*, none. *Hydrants*, Bourbon, 36. *Valves*, Bourbon.

Consumption, 30,000 galls. *Pressure*: Ordinary, 87 lbs. Fire, 87 lbs.

Financial.—Cost, $18,000. Debt, $15,000. Int., 5 and 6%. Ann. op. exp., about $700. Ann. rev.: consumers, about $700; city, none.

Management.—Secy., G. C. Parsons. Supt., Chas. Tight.

HAMILTON, *Butler Co.* (Pop., 12,122; est., 17,000.) On Miami river, 20 miles from Cincinnati. Manufactures agricultural implements.

History.—Built in '84 by city.

Water Supply.—Wagner steamed filter wells, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: Gordon & Maxwell pumps, and 12-flue boilers.

Reservoir.—Cap., 6,703,885 galls.

Distribution.—*Mains*, c. i., 27 miles. *Services*, w. i., lead. *Taps*, 989. *Meters*, 51. *Hydrants*, Mathews, 212.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 lbs.

Financial.—Cost, $354,000. Debt, $350,000. Int., 5%. Ann. op. exp., $8,000. Ann. rev.: consumers, $11,000; city, $12,000.

Management.—Three Trustees. Secy. and Supt., R. N. Andrews.

IRONTON, *Lawrence Co.* (Pop., 8,857; est., 12,000.) On Ohio river. Engaged in river commerce, iron and coal mining, and has iron manufactories, nail mills, machine shops and tool works.

History.—Built in '70-1 by city. Engrs. and Contrs., Coverdale & Weir, address not known.

Water Supply.—Ohio river, pumping to tank.

Pumping Machinery.—Dy. cap., 2,500,000 galls.: Holly-Gaskill & McGowan pumps, and tubular boilers.

Tank.—Cap., 160,000 galls.; 40 ft. in diam. and 18 ft. high. Contrs., Lambert Bros

Distribution.—*Mains*, c. i., 8¼ miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and Ohio Pipe Co., Columbus. *Taps*, 1,120. *Meters*, none. *Hydrants*, Chapman, Holly, 126. *Valves*, Chapman, Holly.

Consumption, 1,600,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $180,000. Debt, $155,000; $90,000 at 5, $47,000 at 4, and $18,000 at 8%. Ann. op. exp., $7,000. Ann. rev.: consumers, $12,000; city, none.

Management.—Three Trustees. Supt, E. Lawton.

KENT, *Portage Co.* (Pop., 3,309; est., 4,000.) On Cuyahoga river, 10 miles N. E of Akron. Has water-power, railway machine shops, and manufactories.

History.—Built in '86-7 by Kent Water Co., under 20 years' franchise. Engr., Isaac S. Cassin, Philadelphia, Pa. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Plum creek, pumping to stand-pipe and direct.

Storage and Subsiding Reservoir.—On creek; cap., 10,000,000 galls.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two duplex Holly-Gaskill pumps, and two horizontal tubular boilers, each 5 by 16 ft.

Stand-Pipe.—Size not given. Its top is 200 ft. above pumping station.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i., lead. *Taps*, 128. *Meters*, none. *Hydrants*, Holly, 77. *Valves*, Holly.

Consumption, 300,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—Cost, withheld. Capital stock, $100,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,900. Ann. rev.: consumers, $1,850; city, $3,750. Hydrant rental, $50.

Management.—Prest., Archer N. Martin. Secy., C. G. Hildreth, 45 Broadway, New York City.

KENTON, *Hardin Co.* (Pop., 3,940; est., 6,000.) On Scioto river on rolling ground, in an agricultural and lumber district. Settled in '20; incorp. in '33.

History.—Built in '81-2 by private company, but now owned by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Well, by direct pumping. The well was sunk in limestone, 20 ft. in diam. and 24 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; three pumps, the first one being a Holly-Gaskill.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, 253. *Meters*, 3. *Hydrants*, kind not given, 71.

Consumption, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 85 lbs.

Financial.—Cost, $94,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,000.

Management.—Three Trustees. Supt., Lewis Fisher.

LANCASTER, *Fairfield Co.* (Pop., 6,803; est., 8,000.) On Hocking river, the ground rising from the river and the Hocking canal to a hill 263 ft. above the canal. Settled in 1800 as New Lancaster, and called Lancaster after '05.

History.—Built in '77 for fire protection, and extended in '80-2 for domestic supply. The first works consisted of a small pump and a single line of pipe, taking water from Hocking canal. In '78 a stand-pipe was added. Contr. for masonry, Henry Kraus; for buildings, Jacob Schleckman. Both of Lancaster.

Water Supply.—Gallery and well, pumping to tank.

Gallery and Well.—The gallery is 4 ft. wide, and 4½ ft. high, with brick side walls and arched top, and takes water from the bottom. It is in gravel. At first it was 270 ft. long. The gallery connects with a well 20 ft. deep, and 18 ft. in diam. In '82 water rose to the surface and wasted over the top.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; Worthington pump, with 20-in. steam and 12-in. water cylinders, all of 15-in. stroke, lifting and forcing water 133 ft. The first pump was small and the boiler inadequate. For a time steam was piped to the engine from iron works 200 ft. distant.

Stand-Pipe.—Is 18 ft. in diam. and 70 ft. high; 133 ft. above water in suction pipe at well, and 64 ft. above pump. Contrs., Matherwell Iron Works, Lancaster.

Distribution.—*Mains*, 12, 10 and 6-in. c. i., 6 miles. *Services*, lead. Pipe and specials furnished by Cincinnati and Newport Iron Works, and trenching and pipe-laying done by R. B. Carothers, both of Newport, Ky. *Taps*, 300. *Meters*, none. *Hydrants*, Chapman, 65.

Consumption, 200.000 galls. *Pressure*, Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost. to Mar. 20, '82, $46,801 for construction and $2,398 for operating. Debt, $25,000. Int., not given. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,000; city, none.

Management.—Three Trustees: J. B. Orman, Geo. Matt and Geo. Lutz. Report by former.

LIMA, *Allen Co.* (Pop., 7,567; est., 17,000.) On Ottawa river, in oil fields. Has manufactories.

History.—Built in '85-7 by city. Engr., J. D. Cook, Toledo. Contr. for masonry and foundations, D. F. Minahan, Springfield; for buildings, Shaler & M——, Lima.

Water Supply.—Surface water, by gravity from impounding to storage reservoir, thence by direct pumping.

Reservoirs.—*Impounding*: area, six acres; depth, 8½ ft. *Distributing*: area, 21 acres; depth, 18 ft.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000-gall. pumps, and three 5½ by 16-ft. boilers, with 55 4-in. tubes. All furnished by Holly Mfg. Co.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. Pipe and specials furnished by Cincinnati & Newport Iron Co., Newport, Ky., and trenching and pipe-laying done by H. N. P. Dole & Co., Columbus. *Taps*, 525. *Meters*, 2. *Hydrants*, Ludlow, Mathews, 159. *Pressure gauge*, Edson.

Consumption, 400,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 75 lbs.

Financial.—Cost, $338,000. Bonded debt, $338,000, $18,000 of bonds having been redeemed since '86. Int., 5%. Ann. op. exp. and rev., not given.

Management.—Prest. of Trustees, Wilbur Fisk. Secy. and Supt., C. A. Melheany.

LORAIN, *Lorain Co.* (Pop., 1,595; est., 3,500.) On Lake Erie at mouth of Black river, 28 miles from Cleveland by water. Manufactures brass goods.

History.—Built in '84 by town.

Water Supply.—Lake Erie, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap., 1,000,000 galls.; horizontal tubular boiler.

Distribution.—*Mains*, Wyckoff wood, 7 miles. *Services*, w. i., lead. *Taps*, 273. *Meters*, 1. *Hydrants*, kind not given, 42.

Consumption, 350,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 150 lbs.

Financial.—Cost, $47,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $3,500; city, none.

Management.—Three Trustees. Prest., Jno. Stang. Secy., T. F. Daniel. Supt., J. D. Stack.

MANSFIELD, *Richland Co.* (Pop., 9,859; est., 1,500.) On Rocky fork of Mohican river, on elevated ground. Has manufactories. Settled '14; incorp. a city in '47.

History.—Built in '70-2 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Five flowing artesian wells and two springs, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon & Maxwell pumps.

Distribution.—*Mains*, c. i., 23 miles. *Services*, w. i. *Taps*, 998. *Meters*, none. *Hydrants*, kind not given. 127.

Consumption, (in '86) 800,000 galls. *Pressure*: Ordinary, 95 lbs. Fire, 95 to 120 lbs.

Financial.—Cost, $195,000. Debt, (in '82,) $950,000. Int., 6 and 8%. Ann. op. exp., $6,926. Ann. rev.; total $10,060.

Management.—Three Trustees. Secy., Wm. Rettery.

MARION, *Marion Co.* (Pop., 3,899; est., 6,000.) Engaged in manufacturing.

History.—Work was begun in spring of '87 by Marion Water-Works Co., Saml. R. Bullock & Co., New York City, having a 20 years' franchise and acting as Contrs. Pipe had been delivered in June, '88, but probable date of completion was not known. Engr., Ellis Morrison, New York City.

Water Supply.—Well, by direct pumping.

Pumping Machinery.—Holly pump.

Distribution.—*Mains*, 4 to 16 in., 10 miles. *Hydrants*, 100.

Financial.—Capital stock, $150,000. Bonds, $150,000. Hydrant rental, $38.

Management.—Address the Co.

MARTIN'S FERRY, *Belmont Co.* (Pop., 3,819; est., 6,000.) On Ohio river nearly opposite Wheeling, W. Va. Manufactures hardware, glass, iron, farming implements, and has woolen and planing mills.

History.—Built in '86-7 by city; water first supplied Dec. 15, '87. Engr., Geo. Hornung, Cincinnati. Substructure of engine house built by city, and superstructure by Ben. Exly, Martin's Ferry.

Water Supply.—Ohio river, pumping to rerservoir and direct.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Gordon & Maxwell vertical duplex pump, and tubular boiler.

Reservoir.—Cap., 2,500,000 galls. Contr., J. Rumsey, Canton.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and trenching and pipe-laying done by J. J. Rumsey, Canton, O. *Taps*, 140. *Meters*, none. *Hydrants*, Bourbon, 47. *Valves*, Ludlow.

Consumption, 20,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $114,000. Bonded debt, $120,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,200; city, none.

Management.—Three Trustees. Supt., B. J. Long.

MASSILLON, *Stark Co.* (Pop., 6,836; est., 11,000.) On Ohio canal, in Tuscarawas coal fields. Manufactures cigars, glass, iron, engines and farming implements, and has sandstone quarries within its limits.

History.—Present works built in '85-6, and put in operation Feb., '87, by Massillon Water Co., under a 20 years' charter. Engr., C. Delafield. Contr., Sam'l R. Bullock's Co. Both of New York City. Works were built as early as '54 but no description of them is given.

Water Supply.—Sippo lake, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two compound condensing Blake pumps, and two 5 by 16-ft. tubular boilers.

Stand-Pipe.—Is 25 ft. in diam. and 150 ft. high; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 17 miles. *Services*, w. i., lead. Pipe and specials furnished by McNeal Pipe and Foundry Co., Burlington, N. J. *Taps*, 586. *Meters*, 9. *Hydrants*, Ludlow, 160. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $287,500. Capital stock, $250,000. Bonded debt, $250,000. Int., 6%. Ann. op. exp., $4,200. Ann. rev.: consumers, $15,350; city, $6,600. Hydrant rental, $41.25.

Management.—Prest., E. Woltmann. Treas., J. G. Warwick. Secy., E. Morrison. Supt., A. W. McCallum.

MEDINA, *Medina Co.* (Pop., 1,484; est., 2,500.) In agricultural section.

General Description.—Built for fire protection by town, date not given. The mains are 8 and 10 in. in diam., and Philadelphia hydrants are used. No other data given.

Report by G. E. Allen.

MIDDLETOWN, *Butler Co.* (Pop., 4,538; est., 5,000.) On Miami river, on level ground, 37 miles from Cincinnati. Engaged in manufacturing. Settled in '15; incorp. a village in '35.

History.—Built in '73-4 by town, under direction of Trustees. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Well, 23 ft. in diam. by 33 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Holly water-power, and Smith & Vaile duplex pumps.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 500. *Meters*, 1. *Hydrants*, kind not given, 75.

Consumption, 500,000 galls. *Pressure*: Ordinary, 43 lbs. Fire, 90 lbs.

Financial.—Cost, $74,000. Bonded debt, $75,000. Int., 5%. Ann. op. exp., (in '85.) $1,200. Ann. rev.: consumers, $4,500; city, none.

Management.—Three Trustees. Report by D. Bowman.

MILAN, *Erie Co.* (Pop., 797; est., 1,500.) On Huron river, 8 miles from Lake Erie.

History.—Built in fall of '88 by village. Engr., J. D. Cook, Toledo. Contr. for all labor, H. K. House, Norwalk.

Water Supply.—Ground water gathered in infiltration reservoir, thence by gravity.

Reservoir.—Is 90 by 144 ft., by 20 ft. deep, with slopes 2 to 1.

Pumping Machinery.—Hugh's improved pump, dy. cap., 1,000,000 galls.; boiler made by Hughes Mfg. Co., Cleveland.

Distribution.—*Mains*, 8 to 4-in. c. i., 3 miles. *Services*, not given. Pipe and specials furnished by Lake Shore Foundry, Cleveland. *Taps*, 150. *Meters*, none. *Hydrants*, Mathews, 22. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $15,000. Bonded debt, $10,000. Int., 5%. Other data not determined.

Management.—Three Trustees. Supt., H. Kelly.

MINERVA, *Stark Co.* (Pop., 565; est., 1,200.) Has car and machine shops, glass and furniture factories.

History.—Built in '86 by town. Des. Engrs., Fairbanks, Morse & Co., Chicago, Ill. Const. Engr., J. C. Harlow, Pittsburgh, Pa. Contrs., Pittsburgh (Pa.) Water & Gas Construction Co.

Water Supply.—Well, on bank of creek, pumping to tank. A pipe connects with the creek for use in case of necessity.

Pumping Machinery.—Dy. cap., 750,000 galls.; Smith & Vaile pump, and vertical boiler.

Distribution.—*Mains*, c. i., 2¼ miles. *Services*, w. i. *Taps*, 70. *Meters*, none. *Hydrants*, Mathews, 25.

Consumption, 25,000 galls, *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 5%. Ann. op. exp., $287. Ann. rev.: consumers, $442.

Management.—Three Trustees. Prest., Geo. F. Yengling. Clerk, Geo. E. McDonald. No Supt.

MOUNT GILEAD, *Warren Co.* (Pop., 1,216; est., 2,000.) On east branch of Olentangy river.

History.—Owned by a company. Address F. A. Talmage. Town Clerk, R. Baxter.

No other data can be obtained.

MOUNT VERNON, *Knox Co.* (Pop., 5,249; est., 7,000.) On Kokosing river.

History.—Finished the middle of '82 by town. Engr., Elias Ebert. Contrs. for masonry and foundations, Dougherty & Ferguson, Newark; for buildings, O. W Hubble, Mt. Vernon.

Water Supply.—Surface and artesian well, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: two Worthington compound pumps, and tubular boilers.

Stand-Pipe.—Is 25 ft. in diam., and 56 ft. high; furnished by Buckley Bridge & Boiler Works, Cleveland.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. Pipe and specials furnished by Mellert Foundry & Machine Co., Reading, Pa., and trenching and pipe-laying done by Merigold & Co., Columbus. *Taps*, 600. *Meters*, none. *Hydrants*, Ludlow, 77. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 97 lbs. Fire, 125 lbs.

Financial.—Cost, $85,000. Bonded debt, $66,000; $12,000 of bonds have been redeemed. Int., 6%. Ann. op. exp., $3,200. Ann. rev.: consumers, $5,000; city, $6,000.

Management.—Three Trustees. Secy., P. B. Chase, Supt., C. W. Koons.

NATIONAL MILITARY HOME, *Montgomery Co.* (Pop., 6,500.) Near Dayton.

History.—Built in '70 by U. S. Government, and supplemental works built in '86. Contrs., Smith & Vaile Co., Dayton. Sub. Contr. for masonry and buildings, Jno. W. Boren, Dayton.

Water Supply.—At first, surface water, pumping to tank. In '86 six 6-in. tubu lar wells were sunk 1½ mile east of the Home grounds, and water pumped from them through a 10-in. main to a reservoir on the grounds, then repumped to tank.

Pumping Machinerry.—Dy. cap., not given; Smith & Vaile pump.

Reservoir.—Not described.

Tank.—Built by Brownell & Co., Dayton.

Distribution.—*Mains*, c. i. 3 miles. *Services*, c. i. Pipe and specials furnished by Ohio Pipe Co., Columbus, O., and trenching and pipe-laying done by Snyder & Williams, Dayton. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 22. *Valves*, Eddy.

Consumption, about 400,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 80 lbs,

Financial.—Cost, $37,500. No debt. Ann. op. exp., not given. No revenue.

Management.—Board of Managers. Supt., I. P. Evans.

NEWARK, *Licking Co.* (Pop., 9,600; est., 17,000.) On Licking river. Has railway repair shops, glass and stone works.

History.—Built in '85-6 by Moffett, Hodgkins & Clarke, Watertown, N. Y., and owned by them. The franchise is for 10 years. Des. Engr., J. D. Cook, Toledo. Const. Engrs., Henry C. Hodgkins, Watertown, and G. T. Keith, Olean, N. Y.

Water Supply.—Two surface wells, pumping to reservoir. The first well was formed by sinking a timber and masonry caisson, 30 ft. in diam., to a depth of 24 ft., water coming from gravel.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two 2,500,000 galls. Gordon & Maxwell duplex compound condensing pump, and two 100 H. P. return tubular boilers, made by Watertown (N. Y.) Engine Co.

Reservoir.—Cap., 3,000,000 galls.; is 262 ft. above city, and was built under the supervision of Wm. Craig.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. Pipe and specials furnished by Lake Shore Foundry, Cleveland, and Ohio Pipe Co., Columbus, one half by each. *Taps*, 510. *Meters*, 5. *Hydrants*, Bourbon, 205. *Valves*, Bourbon.

Consumption, 400,000 galls. *Pressure*: Ordinary, 120 lbs.

Financial.—Cost, $300,000. Debt, $260,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld; city, $9,825. Hydrant rental, $48 for 200 and $45 for additional.

Management.—Prest., Jno. F. Moffett. V. Prest., H. C. Hodgkins. Treas., J. V. Clarke. Secy., —— Watts. Supt., Chas. B. Stevens.

NEW LISBON, *Columbiana Co.* (Pop., 2,028; est., 3,200.) On Middle fork of Little Beaver river, on undulating ground. Has water-power used in woolen and other manufacturing, and is engaged in coal and iron industries. Settled in '02; incorp. in '25.

History.—Built in '40, and new works built in '88 by town. Contrs. for late works: masonry and foundations, New Lisbon Stone Co.; buildings, R. H. Michaels, New Lisbon.

Water Supply.—Two artesian wells, pumping to reservoir. The first supply was from springs, water being conducted through ½ mile of 4-in. wooden and iron pipe to a reservoir 120 by 250 ft., formed by a stone dam 20 ft. high and 120 ft. long, built across a ravine, and 80 ft. above center of town

Pumping Machinery.—Dy. cap., 300,000 galls.; Gordon & Maxwell duplex pump, and return tubular boilers, 4½ by 16 ft.

Reservoir.—Cap., 400,000 galls. Contrs., New Lisbon Stone Co.

Distribution.—*Mains*, c. i., 4¼ miles. *Services*, w. i. Pipe and specials for new works furnished by Addyston, (O.,) Pipe & Steel Co., and trenching and pipe-laying done by Robt. Rue, Minerva. *Taps*, 69. *Meters*, 2. *Hydrants*, Mathews and Ludlow, 34.

Consumption, 32,000 galls. *Pressure*: Fire, 47 to 115 lbs.

Financial.—Cost, $40,000. Bonded debt, $18,000. Int., 6%. Ann. op. exp., $900, Ann. rev.; consumers, $500; city, none.

Management.—Three Trustees. Secy., C. L. Frost. Supt., W. A. Rankin.

NEW PHILADELPHIA, *Tuscarawas Co.* (Pop., 3,070; est., 5,000.) On Tuscarawas river. Engaged in mining salt, coal and iron, and in manufacturing woolen goods, sheet and muck iron, and farming implements.

History.—Built in '86 by New Philadelphia Water Co., which is controlled by American Water-Works & Guarantee Co., Limited, Pittsburg, Pa. Franchise is for 15 years.

Water Supply.—Wells and Tuscarawas river, pumping to reservoir.

Pumping Machinery.—A 2,000,000-gall. Blake pump.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Hydrants*, 83. No further data given.

Financial.—Capital stock, $100,000. Bonds, $65,000. Int., 6%. Hydrant rental, $36 No further data given.

Management.—Prest., O. P. Taylor. Secy., S. M. Highlands. Treas., W. S. Kuhn, Pittsburgh, Pa. Supt., Sharp & Sons.

NORWALK, *Huron Co.* (Pop., 5,704; est., 7,500.) Engaged in manufacturing.

History.—Built in '71-2, and reconstructed in '78 with J. D. Cook, Toledo, as Engr. No Engr. was employed for the first works, aside from the Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Peru branch of Huron river, by direct pumping.

Reservoir.—A dam across the stream, 1¾ miles from center of town and 58 ft. below it, forms a reservoir from which a flume leads to the pump-well. A new stone dam was built in '80.

Filter.—Proved ineffective. Was of gravel; water passed into and through it horizontally, and its area was too small.

Pump-Well.—Is 23 ft. in diam. and 24 ft. deep; water stands about 16 ft. deep.

Pumping Machinery.—Dy. cap., 2,500,000 galls.: Worthington compound pump with 14-in. water cylinders of 24-in. stroke, and Worthington high-pressure pump with 12-in. water cylinders of 15-in. stroke. These pumps were erected in '77 in place of the Holly pumps put in when the works were built. There are two 5 by 16-ft. boilers

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. *Taps*, 545. *Meters*, none. *Hydrants*, Holly, 110.

Consumption, 900,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 85 lbs.

Financial.—Cost, $125,000. Bonded debt, $3,000, a floating debt of $25,000, and $73,000 of bonds having been cancelled since the works were built. Int., 8%. Ann. op. exp., $5,300. Ann. rev.: consumers, $4,000; city, none.

Management.—Three Trustees. Prest., N. H. Pebbles. Secy. and Supt., A. Joslin.

OBERLIN, *Lorain Co.* (Pop., 3,242; est., 5,000.) Is 8 miles from Elyria.

History.—Built in '87 by town, and put in operation Dec. 23. Engrs., Dunham & Paine, Cleveland. Contrs. for masonry and buildings, Doerzbach & Duker, Oberlin.

Water Supply.—Springs, by direct pumping.

Storage Reservoir.—Cap., 5,000,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. Deane pumps, one duplex compound and one high-pressure, and two horizontal tubular boilers, 4½ by 15 ft.

Distribution.—*Main*, c. i., 7 miles. *Services*, galv. i. Pipe and specials furnished by Buffalo Cast Iron Pipe Co., Buffalo, N. Y., and trenching and pipe-laying done by Philip Sullivan, Fremont. *Taps*, 23. *Meters*, 3. *Hydrants*, Mathews, 60. *Valves*, made by Lorain Mfg. Co.

Consumption, not given.

Financial.—Cost, $54,000. Debt, $50,000. Int., 4½%. Ann. op. exp. and rev., withheld.

Management.—Three Trustees. No salaried Supt. Report by A. A. Wright.

PAINESVILLE, *Lake Co.* (Pop., 3,841; est., 5,000.) On Grand river, 3 miles from Lake Erie and 29 from Cleveland. Engaged in manufacturing and trade.

History.—Built in '82 by Painesville Water-Works Co. Engr. and Contr., B. F. Stephens, Flatbush, N. Y.

Water Supply.—Wells and springs, pumping to stand-pipe and direct.

Storage Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: two 1,000,000-gall. Worthington pumps, and tubular boilers.

Stand-Pipe.—Is 20 ft. in diam. and 72 ft. high.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps*, 300. *Meters*, none. *Hydrants*, Mathews, 50. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 85 lbs.

Financial.—Cost, withheld. Capital stock, $150,000. Bonds, $120,000. Int., not given. Ann. op. exp., $3,500. Ann. rev., consumers, $3,000; city, $4,500. Hydrant rental, $90 for first 50, and $50 for each additional.

Management.—Prest., C. A. Avery. Gen. Mgr., B. F. Stephens, Flatbush, N. Y. Treas., W. W. Wickes. Secy., C. D. Adams. Engr., A. O. Peebles.

PIQUA, *Miami Co.* (Pop., 6,031; est., 10,000.) On Miami river, 28 miles from Dayton. Has manufactories. Settled about 1800.

History.—Built in '75 by city.

Water Supply.—Surface water, by direct pumping. Water is taken from the hydraulic canal which furnished power for manufacturing, and which is fed from the Lewiston reservoir at the headwaters of the Great Miami river.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; one duplex Flanders, and one Gordon & Maxwell pump, the former driven by water-power.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 650. *Meters*, none. *Hydrants*, Mathews, 101. *Valves*, Eddy.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $380,000. Debt, $290,000. Int., 6 and 8%. Ann. op. exp., $2,400. Ann. rev.: consumers, $7,200; city, none.

Management.—Three Trustees. Prest. and Supt., Leopold Kiefer. Secy., J. C. Smiley.

RAVENNA, *Portage Co.* (Pop., 3,255; est., 4,000.) Manufactures glass and carriages.

History.—Built in '85 by town. Engr., J. D. Cook, Toledo.

Water Supply.—Crystal Lake, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Knowles pumps, and two steel tubular boilers.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, galv. i., lead. *Taps*, 550. *Meters*, none. *Hydrants*, Ludlow, 91. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 50 lbs.

Financial.—Cost, $81,000. Debt, $81,000. Int., 5%. Ann. op. exp., $2,600. Ann. rev.; consumers, $5,100; city, none.

Management.—Three Trustees. Prest., D. C. Coolman. Secy., Wm. Grinnell. Supt., W. H. Linton.

SALEM, *Columbiana Co.* (Pop., 4,041; est., 6,000.) Manufactures lumber, machinery, stoves and pumps.

OLD WORKS.

General Description.—Built in '62 by A. Phillips, pumping water from a spring to a tank. The pump was a single-acting plunger of 6-in. bore and 12-in. stroke, and the tank had a cap. of 39,000 galls., was of wood, on a brick tower, 45 ft. above the pump. In '81 an artesian well was sunk, and in '82 a Worthington pump of 5¾-in. water and 6-in. steam cylinder was added. In '81 these works were owned by E. W. Silver, and consisted of four miles of 5 and 3-in. cast-iron pipe, and 275 taps. The town had formerly paid $500 a year for hydrants but was then taking water for fire protection from cisterns, paying $275 a year.

THE PRESENT WORKS.

History.—Built in '87 by Salem Water Co., under a 20 years' franchise. Des. Engr., B. R. Clarke, Boston, Mass. Const. Engr., H. F. Dunham, Cleveland. Contrs., Wisconsin Construction Co., Boston, Mass.

Water Supply.—Artesian wells and surface springs, pumping from collecting reservoir to stand-pipe.

Reservoir.—Cap., 600,000 galls.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: two 1,500,000-gall. duplex compound condensing Blake pumps, and two 80 H. P. return tubular boilers.

Stand-Pipe.—Cap., 260,000 galls.; 25 ft. in diam. and 85 ft. high. Contrs., Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i. 18 miles. *Services*, galv. i. Pipe furnished by Addyston, (O.) Pipe and Steel Co., and specials by Builder's Iron Foundry, Providence, R. I. *Taps*, 725. *Meters*, not given. *Hydrants*, Coffin, 160. *Valves*, Coffin. *Pressure gauge*, Edson.

Consumption, 130,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost., not given. Capital stock, $250,000. Hydrant rental, $25; hydrants placed 500 ft. apart.

Management.—Prest., B. S. Ambler. Treas., A. B. Turner, Supt., A. W. Inman.

SANDUSKY, *Erie Co.* (Pop., 15,838: est., 23,000.) On Sandusky bay, an inlet of Lake Erie, having a good harbor. The city is underlaid with limestone formation, which comes to the surface in many places. Has large lumber, lime, stone iron, fruit, wine and fish industries.

History.—Built in '75-6 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Sandusky bay, pumping to stand-pipe. Water is taken from a cove in the bay which is shut off from contamination with the impurities discharged in the Sandusky river.

Intake Crib.—Octagonal, with an inner diam. of 25, and outer of 45 ft., consisting of two double rows of timber walls, 8 ft. apart, filled between with broken sandstone. It extends from rock bottom to 6 ft. above ordinary water level.

Intake Conduit.—From crib to pump-well, 1,800 ft. long. The first 1,387 ft. is of 36-in. wrought-iron and the remaining 413 ft. a 36-in. brick conduit. The pipe is laid in a trench prepared by dredging and submarine blasting. It was floated and lowered to place by scows and chains. A flanged half-sleeve was riveted on the ends of each section, the two bolted together, then cemented. The crib end of the pipe has a vertical elbow, at the upper end of which is a perforated copper plate screen. In Feb., '80, the copper screen was found to be covered with a tough fibrous fungus growth, which when dried was non-combustible and resembled moss. The intake pipe becoming empty rose from its anchorage and separated at a joint near the coffer dam.

Pump-Well.—In solid rock, 8 by 22 ft., and 21½ ft. deep below the engine house floor. It is lined with brick.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; one 3,000,000-gall. compound duplex condensing, and two 2,000,000-gall. non-condensing, Worthington pumps. All the pumps lift 220 ft.

Stand-Pipe.—Double, the outer pipe being 25 ft. in diam. and 180 ft. high, with a storage cap. above 100 ft. of 276,000 galls. Inside of this is a pipe 3 ft. in diam. and 225 ft. high, for fire protection. Each pipe is built of steel plates, those in the outer one running from ⅜ in. thick at the bottom to 3-16 at the top. The bottom course is leaded into cast iron shoes, constructed in segments with flanges and bolts, and forming when in place a perfect circle. It rests in a groove cut in the solid rock. Riveted to the second course of the pipe are twelve 1⅛-in. iron rods passing 8 ft. into the rock, and secured by lead and wedges. There is an iron staircase on the lake side of the pipe.

Oct. 20, '78, the inner pipe burst 100 ft. below the top, falling against the top of the outer pipe and injuring a section 25 ft. long. After repairs the inner pipe was of ½-in. plates for 140 ft., 3-16 for 60 ft., and ⅜-in. for 25 ft.

Distribution.—*Mains*, c. i., 25 miles. *Services*, w. i., lead. *Taps*, 1,618. *Meters*, 61. *Hydrants*, Lowry, Mathews. *Valves*, Ludlow, Whittier, Klotz & Kromer. *Pressure gauge*, Edson.

Consumption, 1,759,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 95 lbs.

Financial.—Cost, $112,000. Debt, $347,000. Int., 7%. Ann. op. exp., $12,700. Ann. rev.: consumers, $18,000; city, none.

Management.—Three Trustees. Prest., J. J. Kelpley. Secy., Chas. Cross. Supt., Chas. A. Judson. Pumping Engr., Wm. Kelley.

SIDNEY, *Shelby Co.* (Pop., 3,823; est., 6,000.) On Great Miami river, on level plateau surrounded by hills. Engaged in manufacturing. Settled in '20; incorp. a city in '50.

OLD WORKS.

General Description.—Built in '73 by city. Engr., T. R. Scowden. A smal stone dam across Yawawa creek diverted water to a raceway two miles long, which conveyed it to a point where a head of 29 ft. furnished power to drive 800,000-gall. Holly pumps, the water being delivered directly to the mains. The dam formed a reservoir of 7½ acres, having an average depth of 15 ft., 50 ft. below the highest part of the city. To the end of '81 these works had cost $51,000, including the distribution system, which is used for the new works, being somewhat remodelled and extended. The operating expenses in '81 were $300, in addition to which the city paid a rental of $800. The revenue was $560. There were at that time five miles o mains, 40 hydrants and 150 taps.

NEW WORKS.

History.—In '88 new works were designed by Geo. Hornung, Cincinnati, the distribution system of the old works being the only part retained. The contracts were let in '88, separately, and Contrs. are given below. The new works were to be in operation Jan. 1, '89.

Water Supply.—Great Miami river and wells, pumping to stand-pipe.

Pump House.—Contr. for foundations, E. H. Robertson & Fisher; for superstructure, W. W. Robertson, Sidney.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,000,000 and 1,500,000-gall. pumps, and two 5 by 16-ft. tubular boilers, furnished by Gordon Steam Pump Co.

Filter.—Cap., 500,000 galls.; from American Filter Co.

Stand-Pipe.—Is 25 ft. in diam. and 85 ft. high: Contrs., Porter Mfg. Co., Syracuse, N. Y.

Distribution.—(Includes old and new.) *Mains*, c. i., 7 miles. *Services*, lead. The specials for the old works were furnished by J. Wagner. Pipe and specials for new works from Addyston (O.) Pipe & Steel Co., and trenching and pipe-laying done by Keating & Houston. *Taps*, 165. *Meters*, none. *Hydrants*, kind not given, 55. *Valves*, new, Bourbon.

Consumption, 9,000 galls. *Pressure*: (Old works.) Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, about $110,000. Bonded debt, $66,000, of which $16,000 is on the old works. Int., old rate, 6%. Ann. op. exp., $300. Ann. rev.: consumers, $750; city, none.

Management.—Three Trustees. City Engr., W. A. Ginn. Supt., Jacob Wagner.

SPRINGFIELD, *Clarke Co.* (Pop., 20,730; est., 35,000.) On Logonda creek, on gently undulating ground. Manufactures agricultural implements, machinery, iron, turbine water wheels, coffins, engines and windmills. Settled in '04; incorp. a village in '27, and a city since then.

History.—Built in '81-2 by city. Engr., J. D. Cook, Toledo. Contr. for foundations of buildings, C. E. Gillen, Springfield; for superstructure of buildings, Jno. Kershner, Cincinnati.

Water Supply.—Reservoir in gravel, filled by springs, thence by pumping to stand-pipe.

Old Filter.—A filter gallery was first built along the bank of Buck creek, and two wells dug 100 ft. apart, connected by a dry stone culvert, 3 ft. in diam.

New Filter.—Built in '88, and unofficially reported as 900 ft. long, 4 by 5 ft. in cross section, of wood with spaces for water to enter from the gravel formation. Surrounded by broken stone and gravel, is 25 ft. below the bottom of the wells, and will furnish an estimated supply of about 2,500,000 galls.

Reservoir.—Contrs., Ryan & Spellacy, Springfield.

Pump-Wells.—Contr., Albert McIntyre, Springfield.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; compound condensing Cope & Maxwell pumps, and tubular boilers.

Stand-Pipe.—Is 30 ft. in diam., 112 ft. high, and 220 ft. above center of city.

Distribution.—*Mains*, c. i., 32½ miles. *Services*, lead. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and trenching and pipe-laying done by Eugene Buckley, Cincinnati. *Taps*, 1,699. *Meters*, 37. *Hydrants*, Eddy, Chapman, Ludlow, Mathews, Whittier, 285. *Valves*, kind, do.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $438,550. Debt, $400,000. Int., 5%. Ann. op. exp., about $13,000. Ann. rev.: consumers, $23,000; city pays interest on bonds, $20,000, raising the money by taxation.

Management.—Three Trustees. Secy. and Supt., W. R. Smith. Pumping Engr., W. C. Powell.

STEUBENVILLE, *Jefferson Co.* (Pop., 12,093; est., 14,000.) On right bank of Ohio river, on high ground. Low water in the river is 640½ ft. above the sea. Manufactures iron, nails, glassware, china and crockery, machinery, stoves, boilers and woolen goods. Natural gas is used quite generally in the city. Settled in 1797; incorp. a city in '51; extended in '71.

History.—Supplied prior to '35 from springs through wooden pipes. In '35 the town built works and in '67 extended them.

Water Supply.—Ohio river, pumping to reservoir. The supply is taken from the river below the point where the city drainage discharges.

Intake Pipe.—Two 15-in. pipe are laid on the bed of the river for 300 ft. and connect with the pump-well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 150 H. P. engines, with plunger pumps built by Jas. Means & Co., in '67. The pump erected in '35 was a 40 H. P. steam pump, and forced water ¾ miles through 8-in. pipe to a reservoir 192 ft. above the river.

Force Main.—Is 20 in. in diam.

Reservoirs.—Cap., 2,000,000 galls. In '35 a 400,000-gall., and in '67 a 600,000-gall. reservoir was built. It is not stated whether these are still in use, and no description of an additional reservoir is given.

Distribution.—*Mains*, 4 to 20-in. c. i., 30 miles. *Services*, lead. *Taps*, (in '82) 1,725. *Meters*, none. *Hydrants*, Means & Irwin, 140.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 65 lbs.

Financial.—Cost, said to be unknown. No debt. Ann. op. exp., $7,500. Ann. rev.: consumers, (in '81) $16,750; city, $22,000.

Management.—Three Trustees. Secy., R. E. Blinn. Supt., Wm. Hunt.

TIFFIN, *Seneca Co.* (Pop., 7,879; est., 10,000.) On both sides of Sandusky river on level ground, in Clinton township. Engaged in manufacturing. Settled in '10; incorp. a city in '50.

History.—Built in '78-9 by Tiffin Water-Works Co., under a 25 years' franchise. Des. Engr., S. L. Wiley, now of Omaha, Neb. Const. Engr., E. C. Cook. Contrs., Wiley Construction Co.

Water Supply.—Sandusky river, by direct pumping.

Dam.—Built to furnish water-power for pumping, and is 230 ft. long.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; one 2,500,000-gall. Holly reciprocating, one 3,000,000-gall. Holly-Gaskill condensing, and one 1,500,000-gall. direct-acting Knowles pump. Two tubular boilers.

River Crossings.—The pumps being on the north side of the city, one mile above its center, the river is crossed at the pump-house by a 16-in. main, and near the center of the city by a 12-in. A 16-in. main is laid down the south, and a 10-in. main down the north shore.

Distribution.—*Mains*, c. i., w. i., 15 miles. *Services*, w. i. *Taps*, 700. *Meters*, 24 *Hydrants*, Mathews, 109. *Valves*, Eddy, Chapman.

Consumption, 700,000 galls. *Pressure*: Ordinary, 110 lbs.

Financial.—Cost, to '84, $175,000. Debt, not given. Ann. op. exp. and rev., withheld. Hydrant rental, $75 for a certain number and $65 for additional.

Management.—Prest. and Mgr., M. Scannell.

TOLEDO, *Lucas Co.* (Pop., 50,137; est., 80,000.) On both sides of Maumee river, 5 miles from Maumee bay, and 8 from Lake Erie. Ground rises gradually from the river to a level upon which most of the residences are built. Has a harbor and is engaged in shipping and manufacturing. Settled in '32; incorp. a city in '36.

History.—Built in '73-4 by city. Engr., J. D. Cook, Toledo.

Water Supply.—Maumee river, filtered, pumping to stand-pipe. The quality of the water has given dissatisfaction.

Intake Crib.—An irregular hexagon, with two sides 80 ft. long and parallel to the current of the river, and the other four sides each 37½ ft. long. Formed by two rows of ground piles driven close together, with the space between filled on the outside with broken stone, and on the inside with gravel.

Intake Conduit.—From crib to filter basin. Of brick, 5 ft. in diam., 500 ft. long, built in an open trench on land and by means of a coffer-dam in the water.

Filter Basin.—Area, 19,000 sq. ft.; slopes are 1½ to 1, finished with a puddle wall and paved with sandstone. The bottom is of concrete, and beginning below the filtering material consists of 24-in. of broken stone, 6 in. each of 2, 1, ½ and ¼-in. gravel, and 24 in. of fine sand.

The maximum depth of the water is 4 ft., and it passes to a clear water basin through gathering drains and an effluent pipe, thence to the pump-wells.

In '75 the filter bed filled so rapidly with silt that it was almost useless, and since then it has been inadequate.

Pumping Machinery.—Dy. cap., 15,000,000 galls.; two Worthington and one Knowles pumps, each of 5,000,000 galls. cap., and return tubular boilers.

Stand-Pipe.—Of No. 1 charcoal iron, ½-in. thick, 5 ft. in. diam., 224 ft. high, 260 ft. above the river, 240 above the pumps, and is enclosed in an ornamental masonry tower.

Distribution.—*Mains*, c. i., 56 miles. *Services*, lead. *Taps*, 2,875. *Meters*, 325. *Hydrants*, mostly Mathews, 404. *Valves*, "all kinds."

Consumption, 3,700,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 98 lbs.

Financial.—Cost, $1,250,000. Debt, $1,000,000. Int., 8%. Ann. op. exp., in '87, $23,000. Ann. rev.: consumers, $58,000; city, by taxation, $80,000. To Jan. 1, '81, the cost including interest, had been $1,145,477, and the receipts, $152,455. In '80, the receipts were $28,919, and the expenses, $20,777.

Management.—Three Trustees. Secy., D. Segur. Supt., H. Cotter.

TROY. *Miami Co.* (Pop., 3,803; est., 5,000.) On Miami river. Engaged in manufacturing.

History.—Built in '86 by town. Des. Engr., J. D. Cook, Toledo. Const. Engr., Harry Evans, Troy. Contrs., M. Philbin & Co., Chicago. Sub-contr., for masonry, S. Compton, Troy.

Water Supply.—Well, 25 ft. in diam. and depth, with 14 ft. of water, by direct pumping.

Reservoir.—Covers 40 acres, and is used only to store water for power.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Smith & Vaile water-power pump.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i., lead. Pipe and specials furnished by Ohio Pipe Co., Columbus. *Taps*, 315. *Meters*, none. *Hydrants* Mathews, 84. *Valves*, Eddy.

Consumption, 25,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 70 to 90.

Financial.—Cost, $71,000. Debt, $81,000. Int., 6%. Ann. op. exp., $1,095. Ann. rev.: consumers, $1,800; city, none.

Management.—Three Trustees. Prest., C. C. Royce. Secy., I. N. Brice. Supt., Jesse Shilling, Jr.

URBANA, *Champaign Co.* (Pop., 6,252; est., 8,000.) In a rolling country, on nearly level ground, having a gravel subsoil from 10 to 30 ft. below the surface. A small spring-fed stream flows through the town. Settled in 1792; incorp. a city in '67.

History.—Built in '78 by Urbana Water-Works Co., under a 10 years' franchise. Contrs., Holly Mfg. Co., Lockport, N. Y. It is unofficially reported that a new contract was made in '88, the Co. to extend its system to 14 miles of pipe and 110 hydrants, and receive $6,000 rental.

Water Supply.—Well, 20 ft. in diam. by 15 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly pump.

Distribution.—*Mains*, c. i., 10 miles. *Services*, lead. *Taps*, 530. *Meters*, 1. *Hydrants*, Mathews, 74. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $75,000. Capital stock, $40,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, $4,000; city, $7,200.

Management.—Prest., S. L. Wiley, Omaha, Neb. Treas., W. W. Wilson. Supt. F. W. Ambrose.

URICHSVILLE, *Tuscarawas Co.* (Pop., 2,790; est., 3,000.) On Stillwater creek. Has railroad repair shops.

History.—Built in '88. Contrs., McCormick & Moran, Pittsburgh, Pa. Address them or M. Moody, Dennison.

No other data given.

WADSWORTH, *Medina Co.* (Pop., 1,219; est., 3,000.) Is 13 miles from Akron, and 35 from Cleveland. Engaged in coal mining.

History.—Built in '80 for domestic supply by Wadsworth Water-Works Co., under a 10 years' franchise.

Water Supply.—Two springs, by gravity from two receiving reservoirs.

Reservoirs.—One 16 ft. sq. and 20 ft. deep, the other 24 by 32 ft., by 26 ft. deep. Each is constructed of heavily spiked timbers, and is about 1¼ miles from and 84 ft. above the square in the center of the village.

Distribution.—*Mains*, Wyckoff wood. iron, 3½ miles. *Services*, galv. i. *Taps*, (in '86,) 128. *Meters*, (in '86,) 5. *Hydrants*, none.

Consumption, 10,000 galls. *Pressure*: 75 lbs.

Financial.—Cost, $5,000. No debt. Ann. op. exp., $200. Ann. rev.: consumers $1,200; city, none.

Management.—Prest., Sam. Weaver, Supt. and Treas., R. F. Weaver.

WARREN, *Trumbell Co.* (Pop., 4,428; est., 7,000.) On Mahoning river, in coal and iron region.

History.—Built in '86-7 by Saml. R. Bullock & Co., under a 20 years' franchise. Engr., Ellis Morrison. Both of New York City.

Water Supply.—Mahoning river, pumping from filter gallery to stand-pipe.

Filter Gallery.—Not described.

Pumping Machiery.—Dy. cap., 3,000,000 galls.; two compound condensing Deane pumps.

Stand Pipe.—Is 22 ft. in diam. and 140 ft. high.

Distribution, *Mains*, c. i., 12 miles. *Services*, w. i. lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 267. *Meters*, not given. *Hydrants*, Bailey, 100. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $180,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,750. Ann. rev.: consumers, $6,600; city, $4,560. Hydrant rental, $45.

Management.—Prest., E. Woltmann. Treas., E. Morrison. Secy., M. P. Hobart. Supt., Geo. H. Quimby.

WAYNESBURGH, *Stark Co.* (Pop., 622; est., 700.) Has foundry and furniture factory.

General Description.—A small gravity system, with receiving basin for supply from springs, and ½ mile of pipe. Address W. A. Robertson or W. Klotz.

WELLSVILLE, *Columbiana Co.* (Pop., 3,377; est., 5,000.) In Yellow creek township, on Ohio river, on bottom lands, surrounded by hills from 200 to 500 ft. above the river. Has manufactories. Settled in '23; incorp. in '29.

History.—Built by city in '87. Des. Engrs., Edelburn & Cooper. Const. Engr., Jno. A. George.

Water Supply.—Ohio river, pumping to reservoir.

Intake Crib.—Of 8 by 10-in. oak timbers, 12 by 16 ft., by 10 ft. deep, sunk in the river 100 ft. from the shore. In the bottom 11 4-in. cast-iron pipes, 12 ft. long, were driven 10 ft. deep. These were perforated for 3 ft. from the lower end, which is stopped by a wooden plug. Through these pipes water flows upwards into the crib.

Pumping Machinery.—Dy. cap., 400,000 galls.: two duplex Worthington pumps of 18¾-in. steam, and 10½-in. water cylinders, of 10-in. stroke lifting water 33^4 ft. There are two flue boilers.

Reservoir.—Cap., 2,500,000 galls.; in excavation, with diam. of 106 ft. at bottom, and 182 ft. at flow line, 17¾ ft. above. The bottom is covered with broken stone on 20 in. of clay puddle, and the slopes are lined with 4 in. of brick on 15 in. of puddle

Force Main.—Of 10-in. cast-iron.

Distribution.—*Mains*, 8 to 4-in. c. i., 7 miles. *Services*, lead. *Taps*, 600. *Meters*, 2. *Hydrants*, kind not given, 60.

Consumption, 300,000 galls. *Pressure*,: Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—Cost, $62,500. Debt, $60,000. Int., 5¾%. Ann. op. exp., $3,800. Ann. rev.: consumers, $5,900; city, $3,300, being interest on bonds.

Management.—Three Trustees. Supt., A. S. Foge.

WEST CLEVELAND, *Cuyahoga Co.* (Pop., 1,781; est., 5,000.) Adjoins Cleveland.

History.—Built in '78 by town.

Water Supply.—Cleveland Water-Works, through two 4-in. meters at the line dividing the two corporations.

Distribution.—Not given, but entirely separate from Cleveland.

Consumption, total for '87 was 13,037,640 galls., or 35,719 a day.

Financial.—The price paid for water in '87 was $1,352, or about ten cents per 1,000 galls. No further data given.

Management.—Three Trustees. Supt., J. D. Seen.

WOOSTER, *Wayne Co.* (Pop., 5,840; est., 7,000.) In a hilly country between Killbuck and Apple creek. The elevation of the city varies 290 ft. Engaged in manufacturing. Settled in '09; incorp. a village in '17, a city in '69.

History.—Built in '69 after plans by Emil Low, and rebuilt or extended in '76 with Jno. Brinkerhoof as Des., and G. P. Low as Const. Engr. Work on masonry and buildings done by city.

Water Supply.—Springs and well, by gravity from the former, and by pumping from the latter.

Dam.—Forms reservoir built in '69, and is of puddled earth, 300 ft. long and 10 ft. high.

Reservoirs.—Cap., 12,000,000 galls.; two of 6,000,000 galls. each, receiving and distributing spring and surface water. The first one covers about 1½ acres, has an average depth of 10 ft. and is 130 ft. above lowest part of city. One was built by city, and the other by P. Reddick.

Pumping Machinery.—Dy. cap., 500,000 galls.; Worthington pump, taking water from well, and Barrett tubular boiler.

Distribution.—*Mains*, 4 to 12-in. c. i., 11.8 miles. *Services*, ¾-in. galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. and laid by T. B. Keating, Mansfield. *Taps*, 290. *Meters*, Crown, 4. *Hydrants*, Mathews, 103. *Valves*, Eddy.

Consumption, 130,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 55 lbs.

Financial.—Cost, $110,000. Debt, $25,000. Int., 6 and 8%. Ann. op. exp., $1,000. Ann. rev.: consumers, $2,500; city, none.

Management.—Three Trustees. Prest., Moses Morritt. Secy., D. N. Immil. Treas., A. P. Babb. Supt., Z. Potter.

XENIA, *Greene Co.* (Pop., 7,026; est., 10,000.) Manufactures lumber, glass, oil twine, pumps and carriages, and has granite and marble works.

History.—Built in '87 by Xenia Water-Works Co., under a 20 years' franchise. Des. Engr., Jno P. Martin. Const. Engr., Chas. L. Goodhue. Contrs., Goodhue & Birnie, Springfield, Mass. Sub. Contrs. for masonry, A. Kelly & Co., and Chas Russell; for buildings, Geo. Beattie. All of Xenia.

Water Supply.—Springs, pumping direct and to stand-pipe.

Reservoir.—Cap., 6,225,000 galls.

Pumping Machinery.—Dy. cap., 3,500,000 galls.: two compound duplex Gordon & Maxwell pumps, and two tubular boilers.

Stand-Pipe.—Cap., 281,000 galls.; 20 ft. in diam. by 115 ft. high, and was furnished by R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, 6 to 14-in. c. i., 19 miles. *Services*, galv. i., lead. Pipe and specials furnished by Addyston Pipe & Steel Co., and trenching and pipe-laying done by T. B. Carothers, Newport, Ky. *Taps*, 400. *Meters*, National, 4. *Hydrants*, Chapman, 180. *Valves*, Chapman.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 150 lbs.

Financal.—Cost., 205,000. Capital stock, $200,000. Bonds, $200,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.; consumers, not determined; city, $7,500. 'Hydrant rental, $37.50 for first 200.

Management.—Prest., Jno. Little. V. Prest., Jno. P. Martin. Treas., Wm. Birnie, Springfield, Mass. Supt., Geo. F. Cooper.

YOUNGSTOWN, *Mahoning Co.* (Pop., 15,435; est., 30,000.) On both sides of Mahoning river, on hilly ground rising abruptly on the north, and more gradually on the south side to 175 ft. above the river. Engaged in iron manufacturing and coal mining. Incorp. a village in '48 and a city in '67.

History.—Built in '72 by the city. Contrs., Holly Mfg. Co., Lockport N. Y.

Water Supply.—Mahoning river, by direct pumping.

New Conduit.—Built in '88 from new pump-well to river; 50 in. in diam., 154 ft. long, of brick, and is 26 ft. below the surface. It connects with the old pump-well, there being a chamber at the intersection containing two 36-in. gates.

New Pump-Well.—Is 26 ft. deep, 10 ft. inside diam., with brick top 10 ft. high covered with slate.

Foundation of new pump.—Of solid brick and Wampum cement, with a pit in the center, 6 by 25 ft., by 10 ft. deep, in which is the Vacuum pump.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; 3,000,000-gall. Worthington duplex, and 5,000,000-gall. Deane pump, the latter added in '87, and the former was put in in '80 to supplement Holly piston and rotary pumps. Three horizontal and one upright tubular boilers.

Distribution.—*Mains*, c. i., 24 miles. *Services*, lead. *Taps*, 1,418. *Meters*, 85. *Hydrants*, Mathews, 185. *Valves*, Ludlow, Galvin. *Pressure gauge*, Edson.

Consumption, 1,417,911 galls. *Pressure*: Ordinary, 85 lbs. Fire, 100 lbs.

Financial.—Cost., $145,000. Debt, $135,000: $110,000 at 5, and $25,000 at 6%. Ann. op. exp., $10,506. Ann. rev.: consumers, $27,497; city, none.

Management.—Three Trustees. Prest., Jno. O. McGowan. Secy., D. N. Simpkins. Supt., Wilson S. Hamilton.

ZANESVILLE, *Muskingum Co.* (Pop., 18,133; est., 27,000.) On both sides of Muskingum river, a navigable stream, mainly on level land surrounded by hills. In bituminous coal region, and is engaged in manufacturing. Settled about 1800; incorp. a city in '55.

History.—Built in '42 by town. Engr., Elias Elbert.

Water Supply.—Muskingum river, pumping to reservoirs.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000 and 3,000,000-gall. Worthington pumps added in '68 to supplement the double-acting piston pumps put in when the works were built. Zanesville boilers.

Reservoir.—Two, 186 by 100 ft., by 17 ft. deep, and 180 by 200 ft., by 15 ft. deep, respectively. Of brick and stone, 185 ft. above the river.

Distribution.—*Mains*, c. i., 42 miles. *Services*, w. i., lead. *Taps*, 3,219. *Meters*, 3. *Hydrants*, Zanesville, 222.

Consumption, 3,420,854 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, $517,473. Debt, $300,000. Int., average, 4.23%. Ann. op. exp., $19,000. Ann. rev.: consumers, $29,575; city, none.

The op. exp. for '80 were $17,201, and the rev. was $28,097.

Management.—Three Directors. Secy., H. S. Crozier. Supt., R. M. Shup.

Water-Works Projected with Fair Prospects of Construction.

BOWLING GREEN, *Wood Co.* (Pop., 1,539; est., 4,000.) In Center and Plain townships. Engaged in wood-working and lime-burning.

Proposed System.—Ferris & Halladay, Jersey City, N. J., were sinking test wells in Dec., '88, and construction will depend upon results. Address above, or City Clerk, Ira C. Taber.

CAMBRIDGE, *Guernsey Co.* (Pop., 2,883; est., 5,000.) On Will's creek, 24 miles from Zanesville. Has various manufactories, and within city limits there are coal mines, oil and gas wells.

Proposed System.—The last of Nov., '88, the town had previously voted to build works. Address R. T. Scott.

POMEROY, *Meigs Co.* (Pop., 5,660; est., 6,000.) On Ohio river. Engaged in mining coal and manufacturing salt.

Proposed System.—Meigs County Water Co. to pump water from Ohio river directly to mains, using tubular boilers and two compound duplex pumps of 1,500,000 galls. cap. each. To be about 6 miles of Kalamein pipe and 55 hydrants. E. R Davenport, the Engr. and projector of the system has a 25 years' contract for 55 hydrants at a rental of $2,500, each additional to be $50. The surveys have been made, and in Dec., '88, it was thought that work would begin soon. Address E. R. Davenport, Charleston, W. Va.

WASHINGTON COURT HOUSE, *Fayette Co.* (Pop., 3,798; est., 5,150.) Engaged in manufacturing and trade.

Proposed System.—Preliminary surveys were made in '88 and it is hoped that works will be built in '89. The franchise is held by Jno. P. Martin, a contractor of Xenia, O. It is proposed to pump water from springs, wells and reservoirs to a stand-pipe. The pump to have a cap. of 3,000,000 galls., the stand-pipe to be 20 ft. in diam. by 125 ft. high; to be 14 miles of 6 to 14-in. mains and 125 hydrants. The vote was 977 to 66 in favor of works, with a rental of $5,000 a year paid by the town. Address John P. Martin, Xenia, or Frank Johnson, Washington, C. H.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Carey, *Wyandot Co.*; Coshocton, *Coshocton Co.*; Fostoria, *Seneca Co.*; Gallipolis, *Gallia Co.*; Glendale, *Hamilton Co.*; Marietta, *Washington Co.*; Wellston, *Jackson Co.*; Westerville, *Franklin Co.*

INDIANA.

Water-Works Completed or in Process of Construction.

ANDERSON, *Madison Co.* (Pop., 4,126; est., 6,000.) Engaged in manufacturing and trade.

History.—Built in '86 by town. Engr., J. D. Cook, Toledo, O. Contr. for masonry, T. P. Kelley; for buildings, Jacob Ellis. Both of Anderson. Some extensions were made in '87 with Snyder & Williams, Dayton, as Contrs.

Water Supply.—White river, by direct pumping. There is a well 25 ft. in diam. and 30 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon & Maxwell pump. Boilers furnished by Barney & Kilby, Sandusky.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. Pipe and specials furnished by Dennis Long & Co., and trenching and pipe-laying done by Geo. W. Clay, Toledo. *Taps*, 100. *Meters*, none. *Hydrants*, Mathews, 39. *Valves*, Eddy.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $30,000. Debt, $9,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,500; city, none.

Management. — Three Trustees. Prest., Thos. N. Norton. Secy., E. P. Schloter.

ATTICA, *Fountain Co.* (Pop., 2,150; est., 3,000.) On Wabash river, 22 miles from La Fayette. Has manufactories.

History.—Built in '73-4 by town. No Engr. employed and all labor done by local parties.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Deane pump, dy. cap., 288,000 galls.

Reservoir.—Is 20 by 40 ft., and 300 ft. above the pumps.

Distribution.—*Mains*, c. i., 10 miles. *Services*, iron. *Taps*, 265. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, 9,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 45 lbs.

Financial.—Cost, $40,000. Debt, $12,000. Int., 7%. Ann. op. exp., $900. Ann. rev.: consumers, about $1,000; city, none.

Management.—Comm. of Three. Supt., S. C. Mentzer. Report by G. W. McDonald.

BLUFFTON, *Wells Co.* (Pop., 2,354; est., 3,500.) On Wabash river, 25 miles south of Ft. Wayne. Engaged in lumbering and manufacturing.

History.—Built in '86 by town.

Water Supply.—Wells, in rock near Wabash river, by direct pumping. The wells are 25 ft. deep, one being 30 by 80 ft., and the other 25 ft. in diam. They have an inflow of 4,000,000 galls. a day.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Holly pump and steel boilers.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Holly, 36. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 80 lbs.

Financial.—Cost, $18,000. Bonded debt, $16,000. Int., 5%. Ann. op. exp., $1,400. Ann. rev.: consumers, $1,500; city, $400, and county, $200.

Management.—Three Trustees: Jeffrey Bliss, Geo. F. McFarren, J. W. Freeman. Report by L. A. Williamson.

BRAZIL, *Clay Co.* (Pop., 3,441; est., 6,000.) Is 16 miles from Terre Haute, in the Indiana bituminous coal region. Engaged in mining and iron manufacturing. Settled in '38; incorp. a city in '73.

History.—Built in '75 by town. Des. Engr., Jno. McDowell.

Water Supply.—Surface water, by direct pumping from a well 18 ft. in diam. and 20 ft. deep, sunk in a coarse sand and gravel stratum.

Dam and Reservoir.—In '83 a stone dam was built across the valley 80 ft. from the well. It is 60 ft. long, 8 ft. high, and floods 7 acres to an average depth of 5 ft.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; 10-in. duplex Deane pump.

Distribution.—*Mains*, c. i. *Services*, w. i. *Taps*, 161. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, 250,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $30,000. Debt, $28,000. Int., 9%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,600; city, not given.

Management.—Supt., Thos. Henderson.

COLUMBUS, *Bartholomew Co.* (Pop., 4,813; est., 8,000.) On Driftwood river, which is the easterly fork of White river, 41 miles from Indianapolis.

History.—Built in '71 by town. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Driftwood river, by direct pumping. The watershed of the river is of sandstone and slate.

Intake Conduit.—As late as '81 this was a wooden box sunk 5 ft. in the bed of the stream, having its sides and bottom perforated with 1½-in. holes for 12 ft., and filled with pebbles, then its bottom perforated for 300 ft., and the next 100 ft. to the pump-well tight.

Pumping Machinery—Dy. cap., 4,500,000 galls.; a gang of six piston and two rotary Holly pumps, also a 3,000,000-gall. condensing Holly-Gaskill pump, built in '83.

Distribution.—*Mains*, c. i., 10 miles. *Services*, not given. *Taps*, 400. *Meters*, none. *Hydrants*, kind not given, 75.

Consumption, said to be 1,500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, to '76, $52,000. No later or further financial data can be obtained.

Management.—Trustees: S. B. Cook, J. T. Tormehlen and J. A. Trotter. Report by latter.

CONNERSVILLE, *Fayette Co.* (Pop., 3,228; est., 6,000.) On west fork of Whitewater river, on bottom lands, back of which a bluff rises to a height of 95 ft. Settled in '14; incorp. a city in '69.

History.—Built in '69 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Hydraulic canal, formerly the White Water Valley canal, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: two Holly and one Root rotary water-power pumps.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, (in '82) 175. *Meters*, none. *Hydrants*, Holly, 75.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 80 to 90 lbs.

Financial.—Cost, $40,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, for '80-1, $1,200. In '82 the city raised $550 by taxation, which, with half of water rents, was paid to the owners of the water-power for operating the pumps.

Management.—Supt., Jos. Hoover. Report by J. M. McIntosh, Mayor.

CRAWFORDSVILLE, *Montgomery Co.* (Pop., 5,251; est., 11,000.) On Sugar creek.

History.—Built in '86 (put in operation Dec. 16) by Crawfordsville Water-Works Co., under a 20 years' franchise. Des. Engr., S. H. Lockett, New York City. Const. Engr., Jno. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, New York City.

Water Supply.—Van Cleve springs, flowing 3,000,000 galls. a day, by direct pumping and pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two 1,500,000-gall. compound non-condensing, and one 1,000,000-gall. high-pressure Worthington pumps.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. *Taps*, 530. *Meters*, not given. *Hydrants*, kind not given, 130.

Consumption, not given. *Pressure*: Ordinary, 110 lbs. Fire, 130 lbs.

Financial.—Cost, $190,000. Capital stock, $200,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $10,633; city, $5,330. Hydrant rental, $41.66 for 120 and $30 for additional.

Management.—Prest., Jno. S. Brown. V. Prest., Geo. F. Wyman. Secy., E. S. Simpson. Treas., J. W. Maguire, 15 Cortlandt St., New York City.

ELKHART, *Elkhart Co.* (Pop., 6,953; est., 15,000.) On St. Joseph river, at junction of Elkhart river and Christiana creek. On level ground, and has good water-power used in manufacturing.

History.—Built in '84 by the Elkhart Water Co., which is controlled by Fairbanks, Morse & Co., Chicago, Ill. A 20 years' franchise. Engr. for above company, M. M. Moore. Const. Engr., Geo. R. Harlow, of Pittsburg (Pa.) Water & Gas Works Construction Co.

Water Supply.—Surface well, pumping to tank and direct. The well was built on an iron shoe, above ground, and sunk by excavating the gravel to a depth of 25 ft. It is 30 ft. in diam., with a brick curb 16 in. thick and 24 ft. high. The gravel at this point is 32 ft. deep. The test of the well showed a yield of 600,000 galls. a day.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two compound duplex pumps, made by Fairbanks, Morse & Co., and Putnam Furnace Co.'s boilers.

Tank.—Of wood, 30 ft. in diam., and 20 ft. high, on a timber trestle 70 ft. high.

Distribution.—*Mains*, c. i., 11 miles. *Services*, lead. Pipe furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 467. *Meters*, 2. *Hydrants*, Chapman, Mathews. 109. *Valves*, Galvin, Eddy.

Consumption, 300,000 galls. *Pressure*: Ordinary, 38 lbs. Fire, 100 lbs.

Financial.—Cost, $106,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $5,000; city, $8,175. Hydrant rental, $75.

Management.—Prest., C. H. Morse, Chicago, Ill. Secy., O. A. Sharpe. Supt., C. H. Watson.

EVANSVILLE, *Vanderburgh Co.* (Pop., 29,280; est., 60,000.) On a bluff on Ohio river in coal region. Has cotton mill, furniture factories, foundries and other manufactories. Settled in '12; incorp. a borough in '14, a city in '47.

History.—Built in '70-3 by city. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y. Sub-contr. for masonry and buildings, Geo. Laut.

Water Supply.—Ohio river, by direct pumping.

Pumping Machinery.—Dy. cap., not given. The first pumps were a gang of 12 piston pumps of 14-in. bore and stroke, driven by a Holly engine. In '80 a Gaskill engine and four 18-in. pumps of 36-in. stroke were erected.

Distribution.—*Mains*, c. i., 33½ miles. *Services*, galv. i. *Taps*, 2,230. *Meters*, none. *Hydrants*, Holly, 274.

Consumption, about 4,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $500,000. Debt, $300,000. Int., 7.3%. Ann. op. exp., $39,713. Ann. rev.; consumers, $39,850; city, none.

Management.—Three Trustees. Chf. Engr., Jno. Fitz. Clerk, Noah A. Briggs. Inspector, Wm. E. Sherwood.

FORT WAYNE, *Allen Co.* (Pop., 26,880; est., 35,000.) At confluence of Fort Wayne and St. Mary's river, which form the Maumee. Has extensive and varied manufactories.

History.—Built in '80 by city. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., C. S. Brackenridge.

Water Supply.—Large filter basin, by direct pumping.

Filter Basin.—Is 120 by 380 ft., having a filtering area of 38,959 sq. ft., and being excavated in gravel to a depth of 12 ft. below ordinary low water in Spy run, which it joins. A pipe connects with stream so that water can be drawn from it if necessary.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; five-cylinder Holly compound pumps, with 19-in. steam and 11-in. water cylinders of 27-in. stroke, and a duplex non-condensing Holly pump with 18 in. steam and 10-in. water cylinders of 24-in. stroke.

Reservoir.—Cap., 3,000,000 galls.; its flow-line is 97 ft. above center of city. Probably a reserve for fire protection.

Distribution.—*Mains*, c. i., 30 miles. *Services*, lead. Pipe and specials furnished and laid by R. D. Wood & Co., Philadelphia, Pa. *Taps*, 1,669. *Meters*, 133. *Hydrants*, Mathews, Ludlow, Lowry, 252. *Valves*, Eddy, Ludlow. *Pressure gauge*, Edson.

Consumption, 1,400,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $314,000. Debt, $260,000. Int., 6%. Ann. op. exp., $9,000. Ann. rev.: consumers, $25,000; city, none.

Management.—Inspector, Frank Iten. Clerk, P. J. McDonald.

GOSHEN, *Elkhart Co.* (Pop., 4,123; est., 6,500.) On Elkhart river. Has good water-power used in manufacturing. Settled in '43; incorp. a city in '67.

History.—Built in '81 by town.

Water Supply.—Six artesian wells, 50 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Deane pumps of equal capacity.

Reservoir.—Of brick, 28 ft. in diam. and 26 ft. deep. Water was formerly pumped to this.

Distribution.—*Mains*, Wyckoff wood, 8 miles. *Services*, galv. i. *Taps*, 400. *Meters*, none. *Hydrants*, Holly-Gaskill, Ludlow, 83. *Valves*, kind, do.

Consumption, 350,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $55,000. Debt, $18,000. Int., 5%. Ann. op. exp., $3,500. Ann. rev.: consumers, $2,600; city, $1,000.

Management.—Commrs. Supt., Lew Wanner.

GREENCASTLE, *Putnam Co.* (Pop., 3,644; est., 9,000.) Has manufactories.

History.—Built in '86 by Greencastle Water-Works Co., under a 20 years' franchise. Engr., Ellis Morrison. Contrs., Saml. R. Bullock's Co. Both of New York City.

Water Supply.—Walnut creek, pumping to stand-pipe from impounding reservoir.

Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 3,000,000 galls; two 1,500,000-gall, compound condensing Deane pumps.

Stand-Pipe.—Is 22 ft. in diam. and 140 ft. high; furnished by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 280. *Meters*, not given. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $175,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,800. Ann. rev.: consumers, $7,580; city, $4,500. Hydrant rental, about $53.

Management.—Prest., Jno. W. Earp. Treas., E. Woltmann, 11 Wall St., New York City. Secy., W. L. Stevenson. Supt., J. L. Daggy.

HAMMOND, *Lake Co.* (Pop., est., 4,000.) On Grand Calumet river. Manufactures whiskey, syrup, chemicals, flour, brick, nails and carriages.

General Description.—Begun Apr. 18, and were to be finished June 20, '88. To be owned by town. Contrs., E. B. Wingate, Winfield, Kan., and Jno. Grubbins, Chicago, Ill. Water to be pumped from well to stand-pipe. Est. cost, $50,000, to be met by bonds. Clerk of Trustees, H. Hall. No further data given.

INDIANAPOLIS, *Marion Co.* (Pop., 75,056; est., 120,000.) On east bank of river on a plain sloping upwards to the southwest about 15 ft. to the mile, and being about 30 ft. above low water at the river. On a bed of gravel 30 to 60 ft. deep, underlaid with 5 to 10 ft. of clay, beneath which is another bed of gravel. The ground water in the upper gravel rises from the river level about 20 ft. to the mile, and furnishes a large part of the water used for domestic purposes. It is badly contaminated by drainage. The city was founded in '19.

History.—Built in '70 by a private company, name not given, when population was 30,000. In '80 or '81 the works were sold at sheriff's sale, and since the Indianapolis Water Co. organized, who improved and extended the system according to recomendations by J. J. R. Croes, New York City. J. H. Dennis was Res. Const. Engr. of the extensions.

Water Supply.—Filter gallery on bank of White river, by direct pumping. The gallery is 2,000 ft. long, partly covered and the rest open, and about 1½ miles from the pump-well.

Water was first taken from two wells near the river, 20 ft. in diam. and 80 ft. apart, sunk 10 ft. below low water in the river and connected by a tunnel. In one of the wells a 4-in. pipe was driven 80 ft., but this gave a small yield, the water from the lower stratum being strongly impregnated with mineral salts.

This supply soon became inadequate and water was then drawn directly from the river at a concave bend. Drainage from mills and factories passed close to the bank and over the intake pipe. In '79 a crib filled with stone was sunk in the river and covered with gravel. It was 25 by 50 ft., and 4 ft. high, the suction pipe connecting with one end. The object of the crib was to provide filtered water. May 14, '81, the crib broke, and considerable sand was drawn through the whole system.

Pumping Machinery.—Dy. cap., 22,000,000 galls., with 10,000,000 galls. additional contracted for. All Holly-Gaskill pumps, some driven by water-power. The boilers are Holly. The contract let in '88 was for two 250 H. P. Holly-Gaskill engines to be used when water is low to drive two 5,000,000-gall. water-power pumps.

The company owns an old canal, now used for water-power only, and when the works were started three turbine wheels were used to drive three rotary and six single-acting Holly pumps. A supplementary Holly steam engine was used. In '80 a Holly engine with four inclined 34-in. steam cylinders, connected to a fly-wheel, and four 15-in. pumps of 37-in. stroke were erected, the old pumps being badly worn.

Ditribution.—*Mains*, c. i., 78 miles. *Services*, lead. *Taps*, 1,974. *Meters*, 150. *Hydrants*, Murdock, Holly, Mathews, 632.

Consumption, 5,000,000 galls. *Pressure*: Ordinary, 55 to 60 lbs. Fire, 120 lbs.

Financial.—Capital stock, $500,000. Cost, withheld. Bonded debt, $550,000. Int. 6%. Ann. op. exp., withheld. Ann. rev.: consumers, $78,955; city, $32,574. Hydrant rental, $50.

For the year ending Sept. 30, '80, the expenses of the old company were $66,019, and the revenue $75,064. There were then $1,100,198 of outstanding bonds. For the three years ending Sept. 30, '80, the expenses exclusive of interest were $137,664, and the revenue $213,483.

Management.—Prest., Thos. A. Morris. Secy., M. A. Morris. Supt., V. Prest. and Treas., F. A. W. Davis.

JEFFERSONVILLE, *Clark Co.* (Pop., 9,307; est., 15,000.) On Ohio river opposite Louisville, Ky. Engaged in manufacturing.

History.—Built in '87-8 by Jeffersonville Water Supply Co., under a 50 years' franchise. Engr., E. F. Fuller, New York City. Res. Const. Engr., Geo. C. Stevens. Contr., Saml. R. Bullock, New York City.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. compound condensing Holly pumps.

Stand-Pipe.—Is 15 ft. in diam. and 150 ft. high; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, 6 to 14-in. c. i., 10 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Hydrants*, Ludlow, 110. *Valves*, Ludlow.

Financial.—Capital stock, $200,000. Bonded debt, $200,000. Int., 6%. Rev. from city, $6,250. Hydrant rental, $56.81.

☛ **Management.**—Prest., E. Woltmann, 11 Wall St., New York City. Treas., N. P. Hobart. Secy., C. M. Berrian.

NOTE:—Not finished at time of report.

KENDALLVILLE, *Noble Co.* (Pop., 2,287; est., 3,000.) Has various manufactories.

History.—Completed Dec. 31, '87, by city. Des. Engr., J. D. Cook, Toledo, O.

Water Supply.—Well, by direct pumping.

Pumping Machinery.—Dy. cap., 150,000 galls.; compound non-condensing Knowles pump, and two horizontal tubular boilers.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and trenching and pipe-laying done by Snyder & Williams, Dayton, O. *Hydrants*, Mathews, 18. *Valves*, Flower.

Financial.—Cost, about $16,000. Debt, $13,000. Int., 3%.

Management.—Prest. Water Board, D. C. Walling. Supt., H. Krueger.

KOKOMO, *Howard Co.* (Pop., est., 8,000.) On Wildcat river. Engaged in lumbering and manufacturing. Has natural gas wells.

History.—Built in '87-8 by Kokomo Water-Works Co., which is controlled by American Water-Works and Guarantee Co., Limited, Pittsburg, Pa. Franchise is for 15 years. Contr. for buildings and pipe-laying, A. W. Stevens, Logansport.

Water Supply.—Wildcat river, by direct pumping.

Filter.—National, dy. cap., not given.

Pumping Machinery.—Deane pump, dy. cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 9.7 miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 120. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $102,000. Capital stock, $125,000. Bonded debt, $85,000. Int. 5%. Hydrant rental, $28.33.

Management.—Gen. Mgr., W. S. Kuhn, Pittsburg, Pa. Supt., E. W. Connell.

NOTE:—Other data not determined at time of report.

LA FAYETTE, *Tippecanoe Co.* (Pop., 14,860; est., 17,000.) On Wabash river on rolling ground. Has water-power used in manufacturing. Incorp. in '25.

History.—Built in '75-6 by city. Engr., Henry Earnshaw, Cincinnati, O.

Water Supply.—Wabash river, pumping to reservoir and direct, and to standpipe for fire pressure in highest part of city.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Clapp & Jones double beam condensing engine driving two 9 in. double-acting pumps of 2,000,000 galls. cap., and Clapp & Jones single beam compound condensing engine driving a 16-in. double-acting pump of 3,000,000 galls. cap.

Force Main.—Is 16 in. in diam. and 10,000 ft. long.

Reservoir.—Cap., 5,000,000 galls. The first reservoir was 60 by 120 ft., in earth embankment above natural surface. Inner slopes were puddled with clay and paved with cobble stones, grouted with cement. Bottom was covered with 1 ft. of concrete. Contrs., Wm. Wallace & Bros., La Fayette.

Stand-Pipe.—In center of reservoir, 24 ft. in diam. and 7 2 ft. high.

Distribution.—*Mains*, c. i., 18½ miles. *Services*, lead. Pipe and specials furnished by Lake Shore Foundry, Cleveland, O., and trenching and pipe-laying done by Wm. Wallace & Bros., La Fayette. *Taps*, 1,127. *Meters*, 18. *Hydrants*, Ludlow 186. *Valves*, Ludlow.

Consumption, 1,100,000 galls. *Pressure*: Average, 60 lbs.

Financial.—Cost, $360,000. Bonded debt, $300,000. Int., 8%. Ann. op. exp., $12,500. Ann. rev.: consumers, $19,000; city, none.

The expenses in '80 were $11,180, and the revenue, $11,506.

Management.—Three Trustees. Supt., Jno. Barnet.

LA PORTE, *La Porte Co.* (Pop., 6,195; est., 10,000.) On a high plateau on the border of Clear lake, one of a chain of seven small lakes. Is 59 miles from Chicago. Settled in '30, incorp. a city in '52.

History.—Built in '70 by city. Engr., Birdsall Holly of the Holly Mfg. Co., Lockport, N. Y., who were the Contrs.

Water Supply.—Clear lake, by direct pumping. The lake is 4 by 7 miles.

Intake Conduit.—Of wood, 16 in. in diam. and 800 ft. long, ending where the water is 40 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; at first there were six 12-in. piston pumps of 12-in. stroke geared to a Holly engine, and two rotary pumps for fire protection. It is not stated whether additions have been made.

Distribution.—*Mains*, c. i., 18 miles. *Services*, w. i., lead. *Taps* 350. *Meters*, none. *Hydrants*, mostly Holly with some Mathews, 102. *Valves*, Ludlow.

Consumption, 700,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $152,000. Debt, $60,000. Int., 7%. Ann. op. exp., $6,000. Ann. rev.: consumers, $6,000; city, none.

Management.—Three Trustees. Supt., G. H. Storey.

LIGONIER, *Noble Co.* (Pop., 2,010; est., 2,500.) On Elkhart river, 25 miles from Elkhart. Has manufactories.

History.—Built in '88 by village; to be put in operation Jan. 19, '89. Engr., W. E. Hinsdale, Beloit, Wis. Contrs., Fairbanks, Morse & Co., Chicago.

Water Supply.—Well, pumping to tank and direct.

Pumping Machinery.—Deane pump, dy. cap. not given.

Tank.—Cap., 50,000 galls.

Distribution.—*Mains*, 8, 6 and 4-in. c. i., 2 miles. *Hydrants*, Mathews, 17.

Financial.—Cost. est., $15,000; covered by bonds.

Management.—Prest. Trustees, C. F. Ellis. Report by J. H. Hoffman.

LOGANSPORT, *Cass Co.* (Pop., 11,193; est., 18,500.) On Wabash at mouth of Eel river, the business part of the city being between and 40 ft. above the rivers. Two miles back the ground rises to a height of 200 ft. A railroad center. Settled in '28; incorp. a city in '38.

History.—Built in '75-6 by city. Des. Engr., Henry Earnshaw, Cincinnati, O. Const. Engr., Walter A. Osmer, Logansport. Contr., H. R. Smith & Co., except for buildings and pumps, the Contrs. for the latter being Cope & Maxwell, Hamilton, O.

Water Supply.—Eel river, by direct pumping. The river has a drainage area of about 3,000 sq. m.

Dam.—Of timber to give water-power.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; four 11-in. Cope & Maxwell piston pumps of 24-in stroke, driven by two 54 and one 40-in. turbine water wheels, with auxilliary steam engines.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. *Taps*, 900. *Meters*, none. *Hydrants*, Ludlow, 115. *Valves*, Ludlow.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $210,000. Debt, $115,000. Int., 6%. Bonds to the amount of $172,000 were issued to build the works. Ann. op. exp., $4,900. Ann. rev.; consumers, $15,000; city, none.

Management.—Three Trustees. Supt., Wm. Schrier. Report by Walter A. Osmer.

MADISON, *Jefferson Co.* (Pop., 8,945; est., 10,000.) On the Ohio river. Engaged in manufacturing. Incorp. a town in '25, and a city in '38.

History.—Built in '49 by city, with Thos. J. Goodman as Des. Engr., and Theo. R. Scowden as Const. Engr. Rebuilt or extended by city in '71-2, under the direction of Trustees Jno. Kirk, J. W. Hinds and J. T. Allison, and with Cobb & Stribling, Madison, as Engrs.

Water Supply.—Ohio river, pumping to reservoir. Formerly a dam across a ravine impounded surface water in a reservoir holding about 6,000,000 galls. The supply was then from this, and from the Ohio river.

Pumping Machinery.— Dy. cap. and make not given; two double acting 9½-in. piston pumps of 72-in. stroke.

Reservoirs.—In '82 two were in use, one 80 ft. in diam. and 20 ft. deep, the other 73 ft. in diam. and 16 ft. deep. Each was 212 ft. above the river.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. *Taps*, 700. *Meters*, none. *Hydrants*, Galvin, Ward & McClellan, 240. *Valves*, kind, do.

Consumption, (in '86,) 465,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 85 lbs.

Financial.—Cost, $250,000. Bonded debt, 8%. Ann. op. exp., for '86, $6,500. Ann. rev.: consumers, for '86, $7,000; city, none.

Management.—Three Trustees. Prest. and Supt., W. W. Hinds.

MARION, *Grant Co.* (Pop., 3,182; est., 6,500.) On level ground on Mississinewa river.

History.—Built in '77 by city. Engr., J. D. Cook, Toledo, Contrs., Dean Bros., Indianapolis.

Water Supply.—Well, by direct pumping. The well is 25 ft. in diam. with a brick curb 16 in. thick, built on a timber shoe and sunk 26 ft. in gravel by excavating from the inside. A pipe was driven 42 ft, through hardpan to another water-bearing stratum, water from which rose 16 ft. above the surface of the ground.

Pumping Machinery.—Dy. cap., not given; Deane duplex high-pressure pump with 18-in. steam and 10-in. water cylinders of 14 in. stroke.

Distribution.—*Mains*, c. i., 8 miles. *Services*, lead. *Taps*, (in '84,) 303. *Meters*, none. *Hydrants*, Ludlow, 57.

Consumption, in '84, 250,000 galls. *Pressure*: Ordinary, 25 to 30 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, $40,000. Debt, $2,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,500; city, none.

Management.—Trustees. Prest., D. S. Hogan. Clerk, H. J. Lenox.

MICHIGAN CITY, *La Porte Co.* (Pop., 7,366; est., 10,000.) On Lake Michigan at the mouth of Trail creek. Engaged in lake commerce, lumber trade and manufacturing. Settled in '33; incorp. a city in '35.

OLD WORKS.

General Description.—Built in '75 by city after plans from Daniel Kennedy. A 1,500,000-gall. Worthington pump lifted water 80 ft. from Trail creek, near its mouth, to a wooden tank 28 ft. in diam. and 14 ft. deep having a cap. of 64,481 galls., and an elevation above the city of from 40 to 72 ft. By direct pumping a fire pressure of 100 lbs was obtained. The old distribution was retained for the new works, the rest of the plant being abandoned.

PRESENT WORKS.

History.—Finished Sept. ,1 '88, by city. **Engr.**, Geo. C. Morgan, Chicago. **Contr.** Ravell & Pipple.

Water Supply.—Crystal springs, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Holly-Gaskill pump, and two 60 H. P. steel boilers.

Tank.—Cap., 120,000 galls; furnished by the contractors.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 250. *Meters*, none. *Hydrants*, Flower, 102, *Valves*, Flower.

Consumption, 450,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $80,000, for old and new works. Debt, $15,000. Int., 5½%. Ann. op. exp., $4,000. Ann. rev.: consumers, $3,500; city, none.

Management.—Three Trustees. Supt., Jno, Renkawitz.

MISHAWAKA, *St. Joseph Co.* (Pop., 2,640; est., 4,000.) On St. Josephs river, 4 miles from South Bend. Has manufactories.

History.—Built in '73 and extended in '83 and '89 by Perkins Windmill & Axe Co. Engr. P. C. Perkins, Mishawaka. No Contrs. for labor.

Water Supply.—St. Joseph river, by direct pumping.

Pumping Machinery.—Dy. cap., not given; Holly double-acting piston water-power pump, with auxiliary steam engine.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps* 52. *Meters*, none. *Hydrants*, Indianapolis, 26.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, not given. No debt. Ann. op. exp., $350. Ann. rev.: consumers, $125; city, $350, or about $14 for each hydrant.

Management.—Prest., P. C. Perkins. Supt., M. M. Fisher. Report by Jno. J. Schindler.

MOUNT VERNON, *Posey Co.* (Pop., 2,730; est., 5,000.) On Ohio river about 18 miles below Evansville.

History.—Built in '60 by Mount Vernon Water Co., which is controlled by the American Water-Works & Guarantee Co., Limited, Pittsburgh, Pa. The franchise is for 20 years.

Water Supply.—Ohio river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake pump.

Stand-Pipe.—Cap., 175,000 galls.; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, withheld. Capital stock, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., withheld. Ann. rev.: consumers, withheld, but est., $12,000; city, about $3,500; Hydrant rental, $46.66.

Management.—Prest. and Supt., R. W. Barnes. Secy., G. V. Menzies. Treas., J. H. Purdy. Gen. Mgr., W. S. Kuhn, Pittsburg, Pa.

MUNCIE, *Delaware Co.* (Pop., 5,219; est., 9,000.) On White river. Has bagging bent wood and other manufactories.

History.—Built in '85 by Muncie Water-Works Co., and operated by American Water-Works & Guarantee Co., Limited, Pittsburgh, Pa. Franchise runs for 20 years.

Water Supply.—White river, by direct pumping from settling basin.

Settling Basin.—Not described.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington pumps, and tubular boilers.

Distribution.—*Mains*, c. i., 9 miles. *Services*, galv. i. *Taps*, 360. *Meters*, none. *Hydrants*, Ludlow, 85. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, withheld. Capital stock, $100,000. Bonded debt, $83,000. Int. 6%. Ann. op. exp., $1,850, natural gas, being used for fuel. Ann. rev.: consumers $5,000; city, $5,000 on 7 miles of pipe.

Management.—Prest., Jas. S. Kuhn, Treas., W. S. Kuhn, Pittsburg, Pa. Secy., J. F. Ross. Supt., H. H. Highlands.

NEW ALBANY, *Floyd Co.* (Pop., 16,423; est., 30,000.) On north bank of Ohio river 4 miles below Louisville, Ky., and two miles below falls of 29 ft. which afford water-power used in manufacturing. The city is on two benches, or plains, rising gradually from the river. Manufactures glass, iron, woolen and cotton goods. Laid out in '13; incorp. a city in '39.

History.—Built in '75 by New Albany Water-Works Co. Engr., Frank Schefold, who has been Supt. since the works were built. Contr., D. C. Hill, deceased. Sub.-contr., for masonry and buildings and reservoir, David Conger.

Water Supply.—Ohio river, pumping to reservoirs.

Intake Pipe.—Is 12 in. in diam., laid to the channel of the river with a strainer on its outer end.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; furnished by Chas. Hegewald, and consists of a single-acting beam and fly-wheel engine with 26-in. steam cylinder driving two 16-in. plunger pumps of 60-in. stroke placed 50 ft. below the engine room floor.

Reservoirs.—Cap., 9,000,000 galls. The first two reservoirs were on a hill 192 ft. above the city, in excavation and embankment, 16 ft. deep, each having a cap. of 1,500,000 galls. Later a 6,000,000-gall. reservoir was built having slopes lined with 9 in. of brick in cement.

Distribution.—*Mains*, c. i., 17 miles. *Services*, lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe-lying done by Thos Mathews. *Taps*, 1,200. *Meters*, 12. *Hydrants*, Mathews, 153.

Consumption, 850,000 galls. *Pressure*: Ordinry, 80 lbs, Fire, 80 lbs.

Financial.—Cost, $265,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 7%. Ann. op. exp., $7,000. Ann. rev.: consumers, $30,000; city, $13,975. Hydrant rental, $100 for first 100, $75 and $60 for each succeeding 100.

Management.—Prest., Chas. Fawcett. Secy. and Treas., Ed. Hangary. Supt., Frank Schefold.

NOTE.—Results of experiments by the Supt. to ascertain heights and distances water could be thrown through hose are given in *Eng. News*, vol. v., p. 286.

NEW CARLISLE, *St. Joseph Co.* (Pop., 530; est., 1,000.) Settled in '40.

History.—Built in '79 by town. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Well, pumping to tank, and in case of fire, direct. The well is 10 ft. in diam. and 35 ft. deep, and four 2½-in. pipes are driven. Water stands in the well 12 ft. deep.

Pumping Machinery.—Dy. cap., 250,000 galls.: Worthington duplex pump of 7-in. bore.

Tank.—Cap., 35,000 galls.; wooden, 18 by 22 ft. and 25 ft. high, placed on a timber trestle.

Distribution.—*Mains*, 6 to 3-in. Wyckoff wood, 2 miles. *Services*, galv. i. *Taps*, 100. *Meters*, none. *Hydrants*, Morgan. *Valves*, Crane.

Consumption, 20,000 galls. *Pressure*: Ordinary, 36 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $10,400. Bonded debt, $4,500. Int., 7%. Ann. op. exp., $575. Ann. rev.: consumers, $400; city, none.

Management.—Three Commrs. (Prest., J. G. Hooten. Secy., Geo. L. Sipe. Treas., S. L. Argabrite. Supt., D. A. White.

PERU, *Miami Co.* (Pop., 5,280; est., 10,000.) On Wabash river, on level ground extending back about ½ mile to bluffs about 100 ft. high. Engaged in manufacturing. Settled about '20.

History.—Built in '79 by city. Engr., J. D. Cook, Toledo, O. Contrs. for masonry and foundations, Jno. Clifton & Co., Peru.

Water Supply.—Wabash river, pumping to reservoir.

Intake Pipe.—Of 20-in. cast-iron, 370 ft. long, connecting crib in river with pump-wells.

Pump-House.—Of brick, with slate roofs. The engine room is 25 by 43 ft., and the boiler room 21 by 36 ft. The chimney is 100 ft. high with smoke flue area of 9 sq. ft.

Pump Wells.—Two, each of brick in cement, 5 ft. in diam. and 22 ft. deep. Water flows through intake pipe by gravity.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; 1,500,000-gall. compound duplex condensing, and 1,000,000-gall. non-condensing Worthington pumps.

Force Main.—A 12-in. pipe 2,446 ft. long, rising 93 ft.

Reservoir.—Cap., 1,250,000 galls. About 116 ft. above the river. Contrs., Earnshaw, Peters and Scully, Cincinnati, O.

Distribution.—*Mains*, 16 to 4-in. c. i., 12.2 miles. *Services*, not given. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by Jno. Knight, Indianapolis. *Taps*, 443. *Meters*, Crown, 4. *Hydrants*, Mathews, Whittier, Lowry, 107 public and 6 private. *Valves*, Eddy.

Consumption, 547,898 galls. *Pressure*: Ordinary, 42 lbs. Fire, 70 lbs.

Financial.—Cost, $115,000. Debt, $100,000. Int., 8%. Ann. op. exp., 3,637. Ann. rev.: consumers, $7,429; city, none.

Management.—Three Trustees: C. H. Nilson, N. A. Hull and A. Fasnacht.

PLYMOUTH, *Marshall Co.* (Pop., 2,570; est., 3,500.) In agricultural region.

History.—Built in '08 by village. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich. Sub-contrs. for driven wells, McAdams & Co.; for pump-well and buildings, Price & Stamberg. Both of Plymouth.

Water Supply.—Four 5-in. driven wells from which water flows to pump-well, thence by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly-Gaskill pump.

Distribution.—*Mains*, Wyckoff wood, iron, 3½ miles. *Hydrants*, Holly-Gaskill, 30. *Valves*, Galvin.

Pressure: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $17,800. Debt, $16,000. Int., 5%.

Management.—Mayor, Jos. Swinell.

NOTE:—Other data not determined.

RICHMOND, *Wayne Co.* (Pop., 12,742; est., 17,000.) Has various manufactories.

History.—Built in '86 by Richmond City Water-Works Co., under an unlimited franchise. Contrs., S. L. Wiley Construction Co.

Water Supply.—Springs, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly-Gaskill-pump.

Reservoir.—Cap., 9,000,000 galls.

Distribution.—*Mains*, c. i., 24 miles. *Services*, galv. i. *Taps*, 900. *Meters*, 30. *Hydrants*, Mathews, 180. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 200 lbs.

Financial.—Cost, $450,000. Capital stock, $250,000. Bonded debt, $200,000. Int. 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $8,000; city, $10,690. Hydrant rental, $60 and $49.

Management.—Prest., D. K. Zeller. Treas., W. P. Hutton. Secy., J. B. Craighead. Supt., F. M. Curtis.

SALEM, *Washington Co.* (Pop., 1,615; est., 2,000.) On Great Blue river. Has manufactories and large stone quarry.

History.—Built in '86 by town. Des. Engr., Jno. M. Henderson, Omaha, Neb. Contr., Moses Shrunn, Salem.

Water Supply.—Spring two miles from town, pumping to reservoir, with direct pumping for fire protection.

Pumping Machinery.—Deane pump, dy. cap., 100,000 galls.

Reservoir.—Is 80 by 120 ft., by 10 ft. deep.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, Bailey, 12. *Valves*, Eddy.

Consumption, 10,000 galls. *Pressure*: 50 to 120 lbs.

Financial.—Cost, $16,000. Debt, $12,000. Int., 5½%. Ann. op. exp., $500. Ann. rev.: consumers, $600; city, free.

Management.—Trustees. Prest., A. Lanning. Secy., J. B. Berkey. Supt., E. Craycroft.

SHELBYVILLE, *Shelby Co.* (Pop., 3,745; est., 5,000.) On Blue river 26 miles from Indianapolis. Engaged in manufacturing and trade.

History.—Built in '86 by Shelbyville Water-Works Co., under a 20 years franchise. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of New York City.

Water Supply.—Well, pumping to stand-pipe. The well is near Blue river in sand and gravel, 35 ft. in diam. and 33 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound duplex Worthington pumps, and two 50 H. P. tubular boilers made by Sinker, Davis & Co., Indianapolis.

Stand-Pipe.—Is 5 ft. in diam. and 125 ft. high.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, 76. *Valves*, Eddy.

Consumption, 22,500 galls. *Pressure*: Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $75,000. Debt, in '86, $70,000. Int., 6%. Ann. op. exp., withheld, but est., $7,000. Ann. rev.: consumers, withheld; city, $4,200. Hydrant rental, $35.

Management.—Prest., Jno, Blessing. Supt., H. Byer. Report by Wm. Morgan.

SOUTH BEND, *St. Joseph Co.* (Pop., 13,280; est., 23,000.) On west bank of St. Joseph river, which furnishes fine water-power. Manufactures agricultural implements, sewing machines and wagons. Laid out in '31.

History.—Built in '73 by town. Engr., H. P. M. Birkinbine. In '80 the works were improved, with E. L. Abbott as Engr. Contr. for masonry and buildings of new works, C. Fasnacht.

Water Supply.—Artesian wells, pumping from receiving reservoir to stand-pipe. There are about 15 wells, averaging 120 ft. in depth, all located in and around the reservoir. Water was formerly taken from St. Joseph river.

Reservoir.—Not described.

Pumping Machinery.—Deane pump, dy. cap., 6,000,000 galls. At first there were three Flanders pumps driven by a turbine water wheel. The Deane pump and a new pump house were added in '80.

Stand-Pipe.—Plate iron, 5 ft. in diam. and 204 ft. high, enclosed in a brick tower.

Distribution.—*Mains*, Wyckoff wood, c. i., 25 miles. *Services*, lead. Lately pipe and specials have been furnished by Crane Bros., Chicago, Ill., Dennis Long & Co., Louisville, Ky., and Lake Shore Foundry, Cleveland, O. Trenching and pipe-laying is done by the city. *Taps*, 1,400. *Meters*, Worthington, Thompson, 80. *Hydrants*, Mathews, 305. *Valves*, Flower.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 95 lbs.

Financial.—Cost, $250,000. Debt, $178,000: $115,000 at 5, and $63,000 at 5½%. Ann. op. exp., $6,000. Ann. rev.: consumers, $10,000; city, none.

Management.—Trustees. Prest., Ed. K. St. John. Supt., Ira S. Schrof.

TERRE HAUTE, *Vigo Co.* (Pop., 26,042; est., 40,000.) On east bank of Wabash river, on a high level plateau about 50 ft. above low water. Has extensive manufactories.

History.—Built in '73 by Terre Haute Water-Works Co.

Water Supply.—Wabash river, by direct pumping.

Filter Bed.—Built so water would pass over it in going to receiving wells. As the river rises 20 to 27 ft. above low water the beds are often submerged and have not proved successful.

Receiving Wells.—Two, each 12 ft. sq. by 8 ft. deep, and connected with the pumps by suction pipes 24 ft. long.

Pumping Machinery.—Dy. cap., 8,000,000 galls. Built by Clapp & Sons, Hudson, N. Y. Two sets of condensing beam engines, each having two 20-in. steam cylinders of 36-in. stroke, and with a 9-in. pump of 36-in. stroke to each cylinder.

Distribution.—*Mains*, c. i., 28 miles. *Services*, lead. *Taps*, 800. *Meters*, 3. *Hydrants*, Mathews, 416. *Valves*, Ludlow.

Consumption, 1,250,000 galls, *Pressure*: Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost, $345,000. Capital stock, $220,000. Bonded debt, $100,000. Int., 8%. Ann. op. exp., $8,000. Ann. rev.: consumers, $34,000; city, $18,000. Hydrant rental, about $40.

Management.—Prest., C. Fairbanks. Secy., J. W. Cruft. Treas., D. Deming. Supt., L. L. Williamson.

UNION CITY, *Randolph Co.* (Pop., 2,478; est., 6,000.) Engaged in manufacturing.

History.—Built in '73 by town. Const. Engrs., Snyder & Williams, Dayton, O.

Water Supply.—Surface well, by direct pumping.

Pumping Machinery.—Deane pump, dy. cap., 250,000 galls., and Root tubular boiler.

Distribution.—*Mains*, Wyckoff wood, c. i., 5½ miles. *Services* and *Taps*, not given. *Meters*, 23. *Hydrants*, not given.

Consumption, 130,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $50,000. Debt, withheld. Int., 8%. Ann. op. exp., $3,443. Ann. rev.: consumers, $2,703; city none.

Management.—Water Board of three. Prest., J. M. Shank. Supt., E. G. Pettis.

VALPARAISO, *Porter Co.* (Pop., 4,461; est., 7,000.) Manufactures wagons and carriages.

History.—Built in '85-6 by Valparaiso City Water Co.

Water Supply.—Flint lakes, 3 m. sq. and 50 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly-Gaskill pumps, and two steel boilers.

Distribution.—*Mains*, Wyckoff wood, 12½ miles. *Services*, lead. Pipe furnished by Michigan Pipe Co., Bay City, Mich., and trenching and pipe-laying done by A. L. Holmes. *Taps*, 225. *Meters*, 27. *Hydrants*, Holly, 55. *Valves*, Flower, Galvin.

Consumption, 350,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 55 lbs,

Financial.—Cost, $100,000. Capital stock, $45,000. Bonded debt, $55,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,000, half being from two R. R. Co.'s; city, $4,250. Hydrant rental, $80 for first 50, and $50 for additional.

Management.—Prest., S. V. Galeno. Secy. and Treas., H. B. Smith. Supt., Don A. Salyer.

VINCENNES, *Knox Co.* (Pop., 7,680; est., 15,000.) On Wabash river. Manufactures paper, lumber, stoves and woodenware.

History.—Built in '85 by Vincennes Water Supply Co., under a 20 years' franchise. Engr., E. F. Fuller. Contrs., Saml. R. Bullock's Co., New York City.

Water Supply.—Wabash river, pumping to stand-pipe. In time of high water the supply is taken from two large filtering wells sunk in the gravel near the river.

Buildings.—Of brick, the chimney being 100 ft. high.

Pumping Machinery—Dy. cap., 4,000,000 galls.; two compound condensing Deane pumps, and three 5 by 18-ft. tubular boilers. The suction pipe is 20 and the force main 18 in. in diam.

Stand-Pipe.—Is 22 ft. in diam. and 200 ft. high; made by Tippett & Wood, Phillipsburg, N. J. Said to have a novel system of inside bracing.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 353. *Meters*, 8. *Hydrants*, Ludlow, 156. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $220,000. Capital stock, $200,000. Bonded debt, $175,000. Int., 6%. Ann. op. exp., $3,850. Ann. rev.: consumers, $9,640; city, $5,000. Hydrant rental, $33.33.

Management.—Prest., E. Woltmann. Secy., E. F. Fuller. Both of 11 Wall St., New York City. Treas., Ed. Watson. Supt., W. B. Chadwick.

WABASH, *Wabash Co.* (Pop., 3,800; est., 10,000.) On Wabash river. Has various manufactories.

History.—Built in '86-7 by Wabash Water Co., under a 20 years' franchise. Engr., C. Delafield. Contrs., Saml. R. Bullock's Co. Both of New York City.

Water Supply.—Treaty creek and springs, pumping to stand-pipe from impounding reservoir.

Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound condensing Holly-Gaskill pumps.

Stand-Pipe.—Is 25 ft. in diam. and 100 ft. high; furnished by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 315. *Meters*, 6. *Hydrants* Ludlow, 100. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $175,000. Capital stock, $150,000. Bonded debt, $130,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $7,150; city, $4,500. Hydrant rental, $45.

Management.—Prest., E. Woltmann. Treas., E. Morrison. Both of 11 Wall St., New York City. Secy., C. M. Berrian. Supt., N. S. Still.

WARSAW, *Kosciusko Co.* (Pop., 3,123; est., 4,000.) On Tippecanoe river. Engaged in lumbering and manufacturing.

History.—Built in '86 by Warsaw Water-Works Co., under a 20 years' franchise. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of New York City.

Water Supply.—Infiltration well and Center lake, pumping to stand-pipe and direct. The well is near the lake, is 25 ft. in diam. and has 18 ft. of water. The lake covers 80 acres and has a clear large stream flowing from it. The brick pump-house is 250 ft. from the lake.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound duplex Worthington pumps, and two 5 by 16-ft. boilers made by Sinker, Davis & Co., Indianapolis.

Stand-Pipe.—Is 5 ft. in diam. and 25 ft. high; made by Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, iron, 6 miles. *Services*, lead, iron. *Taps*, 200. *Meters*, none. *Hydrants*, Mathews, number not given, but est., 88.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $70,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,000; city, $4,000. Hydrant rental, $50.

Management.—Prest., Jas. S. Frazer. Treas., Wm. D. Frazer. Supt., F. F. Porter.

WASHINGTON, *Davriess Co.* (Pop., 4,323.) Is 20 miles east of Vincennes. Engaged in mining and manufacturing.

General Description.—Works being built in '88-9 by Washington Water-Works Co., controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y., who are also the Contrs. Supt. of Const., Clark Kellogg. Water will be pumped to a steel stand-pipe 20 ft. in diam. and 100 ft. high, built by Sharon (Pa.) Boiler Works, Ltd. No further data given in time for insertion. Address Moffett, Hodgkins & Clarke, Watertown N. Y.

Water-Works Projected with Fair Prospects of Construction.

FRANKLIN, *Johnson Co.* (Pop., 3,116; est., 4,000.) Is 20 miles from Indianapolis.

Proposed System.—The town wishes to give a franchise to a company who will begin to construct works in the spring of '83, pumping from wells or stream to stand-pipe. About 6½ miles of pipe and 70 hydrants would be required. Chairman Comm., Frank McCullough.

GREENSBURGH, *Decatur Co.* (Pop., 3,138; est., 4,000.) Has stone quarries and manufactories.

General Description.—The Greensburgh Water Co. began the construction of works in July, '88. The franchise was held by Saml. R. Bullock, New York City, who let the contract to Russell & Craig, Greensburgh. Nov. 28, '88, all work had stopped, little having been done. It was hoped that construction would soon be resumed. The Des. Engr. was E. F. Fuller, New York City, and the Const. Engr., Geo. C. Stevens.

Supply will be from reservoir on stream ½ mile from town, with an est. cap. of 20,000,000, galls., by direct pumping, with two 1,500,000 gall. pumps. There will be about 7½ miles of cast-iron mains, services will be malleable iron, and there is a contract for 100 hydrants, at $35 each. Report by J. W. Craig.

HUNTINGBURGH, *Dubois Co.* (Pop., 781; est., 3,000.) Engaged in manufacturing and coal mining.

Proposed System.—The Citizens' Gas & Water Co. propose to build works in 89, pumping from Patoka river, 2½ miles distant, to a reservoir at an elevation of 100 ft., and lay 5 miles of pipe. The works will cost about $40,000, of which $20,000 had been subscribed by citizens in Dec., '88. Prest., H. Rothers. Secy., C. W. Schwartz

NEW CASTLE, *Henry Co.* (Pop., 2,299; est., 3,000.)

Proposed System.—To be built by village in '89. Consulting Engr., J. D. Cook, Toledo, O. Proposals for construction were to be opened Dec. 12, '88. There will be one 1,500,000 or two 750,000-gall. pumps. Also about 3 miles of 12 to 4-in. cast-iron pipe, and 37 hydrants. Comms.: S. H. Elliott, Chairman; J. C. Livesey and Jno. Hedges.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Dixon, *Greene Co.*; Kentland, *Newton Co.*; Lowell, *Lake Co.*; Portland,; *Jay Co.* Princeton, *Gibson Co.*; Seymour, *Jackson Co.*

MICHIGAN.

Water-Works Completed or in Process of Construction

ADRIAN, *Lenawee Co.* (Pop., 7,849; est., 10,000.) On south branch of Raisin river. Engaged in manufacturing. Settled in '28; incorp. a village in '38, a city in '53.

History.—Built in '83-4 by Adrian Water-Works Co., under a 30 years' franchise.

Water Supply.—Surface and artesian wells, by direct pumping. The surface well is 34.6 ft. in diam. and 23 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. horizontal Holly-Gaskill pumps, and 5 by 16-ft. boiler.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i., lead. *Taps*, 400. *Meters*, 5. *Hydrants*, Holly, 120. *Valves*, Ludlow.

Consumption, 450,000 galls. *Pressure*; Ordinary: 40 lbs. Fire, 90 lbs.

Financial.—Cost, withheld. Bonded debt, $145,000. Int., 7%. Ann. op. exp., $4,500. Ann. rev.: consumers, $4,000; city, $10,000. Hydrant rental, $83.33 for first 120, and $75 for each additional.

Management.—Prest., S. L. Wiley, Omaha, Neb. V. Prest., S. Howell. Secy., K. N. Wiley. Supt. A. F. Haas.

ALLEGAN, *Allegan Co.* (Pop., 2,305; est., 3,000.) In a valley on the Kalamazoo river, which affords good water-power at this point. Engaged in lumbering and manufacturing. Settled in '33; incorp. a village in '37.

History.—Built in '71 by village. Engr., —— Phelps, Kalamazoo.

Water Supply.—Two wells, by direct pumping. The wells are 24 ft. in diam., and on the bank of the Kalamazoo river.

Dam.—Of stone and earth, 8 ft. high. Built across river to furnish water-power for pumping.

Pumping Machinery.—Dy. cap., 1,125,000 galls.; Walker water-power pump. When the works were built two Holly rotary pumps were driven by a turbine water wheel.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, Galvin, 36. *Valves*, Ludlow, Flower.

Consumption, 275,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $45,000. No debt. Ann. op. exp., $1,300. Ann. rev.: consumers, $1,800; city, none.

Management.—Supt., M. Deyer.

ALMA, *Gratiot Co.* (Pop., 925; est., 1,500) On Pine river. Engaged in manufacturing and lumbering. Settled in '54; incorp. a village in '73.

History.—Built in '82 by village. Des. Engr. and Contr., M. Walker, Port Huron, Mich.

Water Supply.—Pine river, by direct pumping.

Pumping Machinery.—Dy. cap., not given. Walker water-power pump of 8-in. bore and 12-in. stroke, and Smith & Vaile steam pump.

Distribution.—*Mains*, Wyckoff wood, 4 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, Holly, 35. *Gates*, Galvin.

Consumption, not given. *Pressure*: Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost, $10,000. Debt, $5,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: not given, est., $1,000.

Management.—Supt., J. M. Montegel, Jr. J. Sarter. Jas. A. Stultz.

ALPENA, *Alpena Co.* (Pop., 6,153; est., 10,000.) On Thunder bay, Lake Huron, at the mouth of Thunder bay river. Has large lumber industries. Incorp. a city in '71.

History.—Built in '79 by Alpena City Water Co.

Water Supply.—Thunder bay and river, by direct pumping. A pump-well on the shore of the bay is connected with a crib in the lake, and a pond on the river.

Intake Crib.—Of timber, bolted together and filled with stone. It is in 16 ft. of water, 1¾ miles from shore.

Intake Pipe.—Of Wyckoff wood, 24 in. in diam. An air pump has been attached to the intake pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Walker and Holly rotary pumps, and tubular boiler, the latter are driven by two Leffel turbines, 87½ and 50 in. in diam., respectively. Formerly there was a Dixon duplex pump of 9-in. bore and 18-in. stroke.

Distribution.—*Mains*, Wyckoff wood, 16 miles. *Services*, lead. *Taps*, 1,046. *Meters*, none. *Hydrants*, Holly-Gaskill, 141.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 33 lbs. Fire, 80 lbs.

Financial.—Cost, $100,000. Debt, $47,500. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $9,010; city, $8,340. Hydrant rental, about $60.

Management.—Prest., W. H. Johnson. Treas., A. W. Comstock. Secy. and Supt., W. E. Rogers.

ANN ARBOR, *Washtenaw Co.* (Pop., 8,061; est., 10,000.) On Huron river Has several manufactories.

History.—Built in '85-6 by Ann Arbor Water Co., under a 30 years' franchise. Engr., Prof. Chas. E. Greene, Ann Arbor. Contrs., Goodhue & Birnie, Springfield Mass.

Water Supply.—Springs and surface water, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,800,000 galls.; Knowles pumps.

Reservoir.—Cap., 9,000,000 galls.; 175 ft. above city.

Distribution.—*Mains*, c. i., 20¼ miles. *Services*, galv. i. *Taps*, 900. *Meters*, 3. *Hydrants*, Pattee & Perkins, 105.

Consumption, 350,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $215,000. Capital stock, $50,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $3,345. Ann. rev.: consumers, $9,864; city, $4,881. Hydrant rental, $45 for 100, and $40 for additional.

Management.—Prest. and Supt., Alex. W. Hamilton. Secy., C. E. Hiscock. Pumping Engr., A. H. Phelps.

AU SABLE, *Iosco Co.* (Pop., 1,328; est., 4,500.) Engaged in lumbering, and in manufacturing salt and shingles.

History.—Built in '85 principally for fire protection by town. Des. Engr., Max. K. Walker, Pt. Huron. Const. Engr., A. L. Holmes, Grand Haven. All labor but pipe-laying done by village.

Water Supply.—Au Sable river, by direct pumping. The water is not fit for culinary purposes.

Pumping Machinery.—Dy. cap., 1,440,000 galls.; Walker pump.

Distribution.—*Mains*, Wyckoff wood, 5 miles. *Services*, ¾-in. w. i. Pipe furnished and laid by Michigan Pipe Co., Bay City. *Hydrants*, Holly-Gaskill, 58.

Consumption, not given. *Pressure*: Ordinary, 35 lbs. Fire, 90 to 100 lbs.

Financial.—Cost and debt, not given, but cost est., $35,000. Ann. op. exp., $1,800. Ann. rev.: consumers, $500; city, none.

Management.—Supt., J. S. Duncan. Report by A. F. McDonald.

BATTLE CREEK, *Calhoun Co.* (Pop., 7,063; est., 14,000.) At junction of Battle creek with Kalamazoo river. Has good water-power, and manufactures boilers, woolen goods, paper, printing presses and threshing machines.

History.—Built in '87 by city. Des. Engrs. and Contrs., MacRitchie & Nichol, Chicago, with W. W. Brigden as Const. Engr.

Water Supply.—Goquac lake, pumping to stand-pipe. The lake has an area of 370 acres, and is two miles from center of city.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. compound duplex Blake pumps, and two tubular boilers, each 5 by 16 ft.

Stand-Pipe.—Is 18 ft. in diam. and 75 ft. high.

Distribution.—*Mains*, c. i., 12.8 miles. *Services*, galv. i., lead. *Taps*, 190. *Meters*, 10. *Hydrants*, kind not given, 116.

Consumption, 160,000 galls. *Pressure*: 70 to 90 lbs.

Financial.—Cost, $127,000. Bonded debt, $100,000. Int., 4½%. Ann. op. exp., about $5,000. Ann. rev.: consumers, about $5,000; city, none.

Management.—Supt. W. W. Brigden.

BAY CITY, *Bay Co.* (Pop., 20,693; est., 33,000.) On Saginaw river, about 4 miles from its mouth, having a river frontage of about 7 miles, and extending back on a plain 10 to 20 ft. above the river. The soil is a heavy, impervious clay, extending 100 ft. to rock. Has extensive lumber and salt industries.

History.—Built in '72 by city, when the population was about 10,000. Previous to this the supply had been entirely from wells and cisterns. The preliminary plans were made by Geo. C. Morgan, Chicago, Ill., after which E. L. Dunbar, the present Chf. Engr. and Supt., was Engr., with Geo. D. Wolcott, Jackson, Mich., Consulting Engr.

Water Supply.—Saginaw bay, by gravity to pumps, thence by direct pumping. An auxiliary supply for fire protection can be taken from the river. In '87 this was necessary nine times, but the aggregate of pumping from the river was but 21½ hours. The bay is shallow, being but 8 ft. deep a mile from the shore, and 16 at three miles. A very heavy and long continued southwest gale reduces the depth of water 4 ft., sometimes for several hours. The water is quite hard and in the summer frequently becomes turbid from the action of the waves on the bottom of the bay, and on the unprotected inner banks of the inlet channel and basin. The latter is four miles from the mouth of the river, and the supply seems free from contamination with the sewage discharged by the stream.

Intake Basin.—To secure a constant supply and protect the intake pipe from ice a basin was constructed 1,500 ft. from the shore. It is 150 by 300 ft. long, by 10 ft. deep, the earth from excavation forming a bank around it. Water is admitted to the basin by an open dredged channel extending to 8 ft. of water, the banks of both the basin and the channel being protected on the outer side by sheet-piling. At the junction of the channel and basin water passes through a timber crib filled with coarse gravel.

Intake Conduit.—Is 21,186 ft. long, 30 in. diam., laid 7 ft. under water at the bay, and having 4 ft. fall to the pumps, which are within the city limits. The conduit is of pine staves, 2 in. thick, from 4 to 6 in. wide, dressed and jointed to a circular form. It was made in 8-ft. sections, with socket joints 3-in. deep, formed by turning off half the thickness of one end and boring out the adjoining end to fit. Elm bands 3 in. wide and ½ in. thick pass twice around the conduit every 2 ft., and are secured with galvanized iron nails. Most of the conduit was laid without difficulty in heavy clay soil, but 2,500 of it is through quicksand, and has settled below grade, allowing sand to enter and slightly impede the flow. The original capacity of the conduit was 5,500,000 galls., which in '81 had been reduced to a little less than 5,000,000.

Pumping Machinery.—Dy. cap., 10,500,000 galls.; one 5,000,000-gall. Holly-Gaskill, and one 3,000,000-gall. Holly quadruplex compound condensing crank and fly-wheel pumping engine, and one horizontal high-pressure piston engine driving two No. 10 Holly rotary pumps with a dy. cap. of 2,500,000 galls. The cost per million gallons pumped in '87 was $7.95; raised 1 ft. $0.743. The cost of fuel for pumping each million gallons was $2.49; raised 1 ft., $0.233. There are three return tubular boilers, each 5½ by 16 ft. The total grate surface is 61½ ft.

Distribution.—*Mains*, 3 to 20-in. Wyckoff wood, and c. i., 25½ miles. *Services*, lead, w. i., Wyckoff wood. *Taps*, 1,332. *Meters*, Crown, Empire, Union rotary and duplex, Worthington, 190. *Hydrants*, Holly, Mathews, Gaskill, Galvin, 190. *Valves*, Flower, Galvin.

Consumption, 2,266,288. *Pressure*, Ordinary, 40 lbs, Fire, 80 lbs.

Financial.—Cost, $430,369, Debt, $385,000: $367,000 at 8, and $18,000 at 4%, Ann. op. exp., $11,740. Ann. rev.; consumers, $19,380; city, no allowances made, but interest on debt, $30,080, is paid by taxation.

To Dec. 1, '80, the cost of contruction was $365,659, and of maintenance and operation, not including interest on $377,000 debt, $70,366. The total receipts to that date were $74,073.

Management.—Seven Commrs. Prest., Andrew Walton. Chf. Engr., Supt. and Secy., E. L. Dunbar, who has served as such since the works were begun.

BELLAIRE, *Antrim Co.* (Pop., est., 600.) On Intermediate river. Manufactures woodenware.

History.—Built in '88 by Robt. Rickardi, and owned by him.

Water Supply.—Cedar river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 100,000 galls.; Knowles water-power pump.

Reservoir.—Cap., 200,000 galls.; 60 ft. in diam., 10 ft. deep, and at an elevation of 200 ft.

Distribution.—*Mains*, 6 in. wood, 4-in. iron, 3 miles. *Services*, not given. *Taps*, 52. *Meters*, none. *Hydrants*, kind not given, 8.

Consumption, unknown. *Pressure*: Ordinary, 78 lbs. Fire, 78 lbs.

Financial.—Cost, $5,500 galls. No debt or stock. Ann. op. exp., not determined. Ann. rev.: consumers, $250; city, about $300. Hydrant rental, "paid by citizens, .08% on perishable property." [Probably a precentage on valuation of property that could be destroyed by fire.—Ed.]

Management.—Owner, Robt. Rickardi.

BESSEMER, *Gogebic Co.* (Pop., est., 4,000.) In iron, mining and, lumbering section.

History.—Built in '87-8 (put in operation Oct. 1) by Gogebic Water & Gas Supply Co. The works changed hands in '88, but no particulars can be obtained.

Water Supply.—Springs, by direct pumping from collecting reservoir.

Reservoir.—Is 30 ft. in diam. and 30 ft. deep.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington duplex pump.

Distribution.—*Mains*, lap-welded w. i., 2 miles. *Services*, galv. i. Pipe and specials furnished by National Pipe & Foundry Co., Scottdale, Pa. *Hydrants*, 24.

Pressure: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Hydrant rental, $100.

Note:—Just completed, and further data not fully determined.

BIG RAPIDS, *Wexford Co.* (Pop., 3,552; est., 7,000.) On Muskegon river, on nearly level ground, the greatest difference in elevation being 35 ft. Has good water-power used in manufacturing. Settled in '60.

History.—Built in '71 by town and improved in '85, changing the source of supply. The first works were designed by the Water Board. Const. Engr., W. R. Coats, Kalamazoo, Mich.

Water Supply.—Driven wells, by direct pumping from collecting reservoir. The first supply was from Muskegon river, by direct pumping from a gravel filter crib.

Reservoir.—Cap., about 30,000 galls.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two Holly duplex pumps. There were formerly two Blake pumps.

Distribution.—*Mains*, c. i., 10 miles. Wooden mains were used, but proved unsatisfactory. *Services*, lead. *Taps*, (in '82), 209. *Meters*, none. *Hydrants*, Ludlow, 84. *Valves*, Ludlow.

Consumption, about 300,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, but est., $50,000. Bonded debt, $35,000. Int., 4½%. Ann. op. exp., about $2,900. Ann. rev.: consumers, withheld, but est., $5,000; city, none.

Management.—Common Council. Supt., S. A. Stambough.

CADILLAC, *Wexford Co.* (Pop., 2,213; est., 6,000.) Manufactures machinery, and has lumber trade.

History.—Built in '78 by company, name withheld. Engr., F. N. Greene, Cadillac. Contr. for masonry, E. George & Co.; for buildings, J. G. Mosser.

Water Supply.—Clam Lake, by direct pumping.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; compound Holly and Davidson pumps. Tubular boilers.

Distribution.—*Mains*, Wyckoff wood, 5 miles. Pipe furnished by Michigan Pipe Co., Bay City, and laid by H. H. Greene. *Services*, lead. *Taps*, 400. *Meters*, none. *Hydrants*, Holly, 40. *Valves*, Galvin.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 110 lbs.

Financial.—Cost, $35,000. Debt, none. Ann. op. exp., $3,000. Ann. rev.: consumers, $8,500; city, $3,000. Hydrant rental, $50.

Management.—Engr., H. H. Greene.

CAPAC, *St. Clair Co.* (Pop., est., 500.)

History.—Built in '87-8 by village, under direction of Trustees. No Engr.

Water Supply.—Tubular well sunk to and into rock, pumping to tank for fire protection only.

Pumping Machinery.—Windmill pump.

Tank.—Cap., about 15,000 galls.; Contr., Gurley Lester.

Distribution.—No mains have yet been laid, but these and hydrants will be put in in '89. At present a hose is attached to the hand engine and tank in case of fire.

Financial.—Cost, $700.

Management.—Village Trustees. Report by D. Patterson.

CARO, *Tuscola Co.* (Pop., 1,282; est., 1,800.) On Cass river, 30 miles from East Saginaw.

History.—Built in '88 by Caro Water Co. Des. Engr., E. A. Abbott. Const. Engr. and Contr., Geo. W. Phelps.

Water Supply.—Springs, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane pump.

Stand-Pipe.—Cap., about 230,000 galls.; 25 ft. in diam., 75 ft. high, and on ground 85 ft. above Main St. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. Pipe and specials furnished by Detroit (Mich.) Pipe Co. *Taps*, 60, expect to have 200 in '88. *Meters*, 7. *Hydrants*, Mathews, 30. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, about $35,000. Capital stock, $25,000. Bonded debt, $30,000, Int., 6%. Ann. op. exp., not determined. Ann. rev: not determined. Hydrant rental, $50.

Management.—Prest., Geo. W. Phelps. Secy. and Supt., C. O. Thomas.

CARSON CITY, *Montcalm Co.* (Pop., est., 1,200.) On Fish creek. Engaged in lumbering.

History.—Built in '88 by village.

Water Supply.—Fish creek, pumping to tank, and direct in case of fire.

Pumping Machinery.—Not given.

Tank.—Cap., about 50,000 galls.

Distribution.—*Mains*, Wyckoff wood, 3,000 ft.; furnished by Michigan Pipe Co., Bay City. *Hydrants*, 20.

Financial.—Cost, $8,000. Bonded debt, $8,000. Int., 6%.

Management.—Report by A. L. Holmes.

NOTE:—Works just begun at time of report.

CENTRAL MINE, *Keneewaw Co.* (Pop., est., 1,100.)

History.—Built in '85 by Central Mining Co. Engr., Jas. Deurstan.

Water Supply.—Creek, pumping to reservoir.

Pumping Machinery.—Gordon & Maxwell pump, dy. cap., not given.

Reservoir.—Is 20 by 66 ft.

Distribution.—*Mains*, iron, 800 ft. *Taps*, 6. *Meters*, none. *Hydrants*, home made, 3.

Consumption, not given. *Pressure*: Ordinary, 150 lbs.

Financial.—Cost, $7,500, No debt. No further data given.

Management.—Jno. Stanton, 76 Wall St., New York City. Report by H. C. Barns.

CHARLOTTE, *Eaton Co.* (Pop., 2,910; est., 4,000.) Is 18 miles from Lansing.

History.—Built in '86-7 by town.

Water Supply.—Wells, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i. lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 350. *Meters*, not given. *Hydrants*, Ludlow, 67. *Valves*, Ludlow.

Consumption, 150,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $45,000. Bonded debt, $40,000. Int., 4%. Ann. op. exp., $3,000, Ann. rev.: consumers, $3,000.

Management.—Commrs.: E. Shepherd, D. B. Ainger and J. T. Wilson.

CHASE, *Lake Co.* (Pop. of township, 1,087; of village, est., 800.) On Pere Marquette river. Engaged in lumbering.

History.—Built in '83 by town, after plans by Wm. Yates, Chase.

Water Supply.—Pere Marquette river, by direct pumping.

Pumping Machinery.—Holly pump, dy. cap., not given.

Distribution.—*Mains*, Wyckoff wood, length not given, but they extend through half the village. *Services*, ¾-in. iron. *Hydrants*, 5.

Pressure: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $11,000. Debt, $2,500. Int., 7%. Ann. op. exp., $800.

Management.—Three Commrs. Village Clerk, J. P. Bean.

NOTE:—No further data can be obtained.

CHEBOYGAN, *Cheboygan Co.* (Pop., 2,629; est., 5,000.) On straits of Mackinaw, Lake Huron and Cheboygan river. On generally level ground, which extends some distance back from the lake, then rises to an elevation of 600 ft. Engaged in lumbering. Settled in '46; incorp. a village in '71.

History.—Built in '82 by village. Des. Engr., Geo. P. Smith.

Water Supply.—Artesian well, by direct pumping. The well is 300 ft. deep, 180 ft. being 7, and 120 ft. 5 in. in diam. If necessary water can be drawn from Lake Huron.

Pump-Well.—Is 24 ft. in diam. and 16 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: two Walker pumps, and two horizontal tubular boilers.

Distribution.—*Mains*, Wyckoff wood, Kalamein i., 4 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, Holly, Ludlow, Bailey, 22.

Consumption, 150,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $34,000. Debt, $25,000. Int., 5½%. Ann. op. exp., $3,000. Ann. rev.: consumers, $1,800; city, none.

Management.—Commrs. Chairman, J. W. McDonald.

CLARE, *Clare Co.* (Pop., 502; est., 1,200.)

History.—Built in '86 by town. Engr., M. Walker, Port Huron.

Water Supply.—Well, 12 ft. in diam., and 23 ft. deep, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap. not given.

Distribution.—*Mains*, Wyckoff wood, 2 miles. *Hydrants*, 11.

Pressure: Ordinary, 40 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $9,000. Bonded debt, $7,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $600.

Management.—Three Commrs. Supt., A. W. McIntyre. Report by Wm. Giberson.

NOTE.—Other data unknown.

CONSTANTINE, *St. Joseph Co.* (Pop., 1,404; est., 1,800.) On St. Joseph river Has good water-power, and is engaged in manufacturing.

History.—Built in '78 by town.

Water Supply.—Fawn river, by direct pumping.

Distribution.—*Mains*, Wyckoff wood, 5 miles. *Services*, galv. i. Pipe furnished by Michigan Pipe Co., Bay City. *Taps*, 158. *Meters*, none. *Hydrants*, Holly, 37. *Valves*, Holly.

Consumption, unknown. *Pressure*: Ordinary, 30 lbs. Fire, 60 lbs.

Financial.—Cost, $22,500. Bonded debt, $15,500: $10,000 at 5, and $5,500 at 6%. Ann. op exp., $250. Ann. rev.: consumers, $520; city, none.

Management.—Recorder, Thos. Harrison.

DETROIT, *Wayne Co.* (Pop., 116,340; est., 200,000; part of the increase is due to annexation of adjoining townships.) On west bank of Detroit river, 18 miles from Lake Erie and 7 from Lake St. Clair. The ground rises from the river about 58 ft. in a mile. Has good harbor, extensive commerce and manufactories. Settled in 1701 by the French, occupied in 1736 by the British, and in 1787 by U. S. Government

THE WORKS PRIOR TO THEIR PURCHASE BY THE CITY IN '36.

In the early part of the century the yield from wells was neither good nor sufficient and water was supplied from the Detroit river by carts and buckets. An ordinance obliged every householder to keep upon his premises a cask containing a given amount of water, for fire protection.

In '24, the population being about 1,000, the Legislature authorized Peter Berthelet to build a wharf on the river at Randolph St., on condition of his erecting a pump on it, water from which should be free to all residents of the city. The pump was erected and used until May 19, '35, when the Common Council ordered its removal.

In '27, the population having increased to 1,500, the Common Council granted Rufus Wells the exclusive right of supplying water. He built a pump house on Berth elet's wharf, 20 ft. sq., with a cupola 40 ft. high, in which was a 40-gall. cask, Two 5-in. horse-power pumps raised water to the cask from which 4½ in. bored logs conveyed it to a reservoir 16 ft. sq. and 6 ft. deep, of 2-in. plank, caulked, standing on a timber frame 16 ft. high. From this it was distributed through 3½ in. bored logs, each family supplied paying $10 a year, quarterly in advance.

In '29 the Hydraulic Co., consisting of Wells and others, spent $6,000 in boring a 4-in. hole 260 ft. deep. No water was obtained. In '30 this company was authorized to supply water until '65, when the works were to be bought by the city at a valuation. The legislature ratified this charter Mar. 2, '31.

A 10 H. P. engine and a rotary pump lifted water through a 3-in. iron pipe to a brick reservoir on Fort street, 18 ft. sq. and 9 ft. deep. Distribution was by two lines of 3-in. logs; most of which were not laid deep enough, and froze up in '30-1, necessitating relaying deeper. In '31 a second reservoir was built adjoining the first, 40 ft. sq., 10 ft. deep, of oak plank. An inclined engine was erected with 12½ in. cylinders of 72-in. stroke, driving the rotary pump until that was replaced by an 11-in. double-acting force pump of 72-in. stroke.

June 4, '35, the company having expended $23,608 above receipts, the city bought the works for $20,500.

THE WORKS FROM THEIR PURCHASE BY THE CITY IN '36 TO THEIR EXTENSION IN '77.

The first extension made by the city after purchasing the works was the construction of a new reservoir, or tank, 400 ft. from the river. This was of iron, an exact duplicate of one built by the Manhattan Co., in New York, the same patterns being used for the castings. It was of iron, 60 ft. in. diam. and 20 ft. deep, on brick walls, and was erected in '37-8 with Noah Sutton as Engr. About this time the pumping wharf was extended, and in June, '41, a direct-acting engine with 20-in. cylinders and 18-in. pump, both of 96-in. stroke, was put in operation. The pump raised water to the new iron tank, whence it was carried by 10,4 and 3-in. iron pipe to the old Fort street reservoir. No overflow was provided for the tank until '54. In this year a 24-in. main was connected with the tank; a tub was used as a coffer dam, 10 ft. in diam. 6 ft. high, of 3-in. staves, hooped, tarred, and having the outside bottom packed around with 2 ft. of clay puddle, protected with canvas. The tub was weighted and sunk, 5 ft. of water being kept in the tank while its bottom was being cut out for the connections.

In '41 the first pumping engine, erected by the company about '30, was abandoned, as was the Fort street reservoir in '42, and the iron tank in '66. Nov. 19, '50, a horizontal engine of 150 H. P. and a new engine house, inclosing the old one, were put in use. The inclined engine, erected by the company in '31 was put on a new foundation and repaired.

Feb. 24, '52, the control of the works was vested in a Board of five, and May, '53, the Legislature created a Board of Water Commissioners.

The inlet pipe of the first engine extended 12, and of the second, 25 ft. beyond the dock, the shore current with its impurities at first passing through a sluice. As the shore became occupied and the river obstructed the sluice filled up, the shore current became more impure, and finally passed over the inlet pipes.

Aug. 28, '58, a new 30-in. inlet pipe, extending 150 ft. into the river, was put in use. It was protected by piles, cut off and filled around with stone. The intake end of the pipe was provided with a bell mouth, turned upwards, 36-in. in diam., surrounded by a strainer of boiler iron 9 ft. in diam. and 10 ft. high. Above the end of the pipe the strainer was perforated with 144 ½-in. holes to 1 sq. ft., and a diaphragm similarly perforated surrounded the top of the pipe. To prevent sand banking around the outside of the strainer 4-in. holes were cut through, below the mouth of the pipe. The mouth of the strainer was placed 25 ft. below the surface, the current here being about three miles an hour.

In extreme cold weather ice sometimes accumulated on the strainer, sometimes preventing the flow of water to the pump-well, which was 18 by 40 ft., by 12 ft. deep, with its bottom 12 ft. below the surface of the river. The trouble was always when ice was forming in the lake and river, and the surface of the river above the strainer was not covered with ice. Also when the thermometer was from 7 to 20 degrees above zero, and at night, or in cloudy weather. When the river above the strainer was covered with ice there was little difficulty, or when the mercury rose above 20 degrees, and when the sun shone brightly no trouble was ever experienced.

This stoppage occurred in the intake pipes laid in '40, '50, and the one just described, but the strainers of the two first pipes were so near the shore that the ice could be removed by poles.

In the winter of '67 a diver was employed who found that the strainer and surrounding piles were covered with a mound of particles of ice, about 15 ft. in diam. and 10 ft. high. The little water admitted came through the down-stream side of the strainer.

In '73 a new inlet pipe was laid, of ¼-in. boiler iron, 30 in. in diam., with flexible joints. This had four strainers, all on the down-stream side, the outer one being provided with a door which could be opened with a rod extending to the shore. More information regarding the ice forming on the strainer is given in *Engineering News*, vol. VIII., p. 194.

From '56-61 a " pair of square engines with double bucket pumps so arranged as to produce a continuous flow of water in one direction, with a guaranteed duty of 150,000 lbs. per lb. of coal " were erected by Dickerson & Sickles, but as the Contrs. could not make them work they were abandoned.

Dec., '63, a pump built after plans by Jno. E. Edwards was put in operation. It was direct-acting, with 42-in. steam cylinder of 96-in. stroke, and pump of 24-in. bore. In '71 another pump, designed by Mr. Edwards, having a cap. of 18,000,000 galls., was put in operation.

The last reservoir.—Built in '54-60, 4,500 ft. from, and with its water surface 77½ ft. above the river. It is not used now. In two divisions, each 200 ft. sq., with earth embankments 30 ft. high paved with brick on the inner slopes. Cap., 10,000,000 galls. It was put in use Nov., '57, before the banks were finished, it being filled deeper as the work progressed. Soon after being finished and filled the banks showed signs of settlement, and on drawing the water from the west basin the inner slopes slid.

They were repaired and covered with dry stone slope walls. The slopes of the east basin were also relaid with stone, and it was brought into use in '60.

Early Distribution.—In '50 there were 4½ miles of iron, and 35 of wooden pipe, the largest of the former being 10, and most of the latter but 2 in. in diam., laid without system. For fire services reservoir were dug in the streets, and in case of fire were filled by kicking a wooden plug out of the adjoining pipe. In '54 it was reported that stop cocks were being substituted for plugs.

Many logs were laid by individuals, with permission from the council. Some were but 1 or 2 ft. below the surface, and in '56 more than four miles were destroyed by freezing and bursting. From '52-7 all pipes laid were of iron, but in '57 the use of logs was resumed, because they were cheaper, good logs well laid lasting 16 years and costing but 1-5 as much as iron pipe. The Commissioners bored the logs, using sound green tamarack, not less than 6-in. in diam. at the smallest end, and 8 ft. long. The joints were covered with iron thimbles, and the pipe laid 5 ft. deep.

THE PRESENT WORKS.

General Description.—Since '77 the city has made important extensions and improvements in the works, building a large new pumping station, a settling basin and stand-pipe. Des. Engr., D. Farrand Henry. It is not stated whether the old pumping station is still in use.

Water Supply.—Detroit river, pumping to stand-pipe. The new supply is taken 4 miles above the old.

Intake Pipe.—Extends from a point 1,100 ft. from the shore to the settling basin. Is 5 ft. in diam. with the outer end on the river bottom, in a crib. It was laid in sections in a dredged trench, being bolted under water.

Settling Basin.—Is 365 by 800 ft., 13 ft. deep at the river, and 17 at the conduit end. The bottom is of solid clay, and the sides are of double rows of sheet-piling, planked, and filled between with 14 ft. of puddled clay. A submerged weir, 75 ft. from the river end, prevents a direct current from inlet to outlet.

Conduit.—Of brick, 5 ft. in diam. From a well 16 ft. in diam. two branches lead to the pump-wells, which are 26 ft. deep.

Pumping Machinery.—Dy. cap., 82,000,000 galls.; the earlier pumps connected with the works have been described above. Since '77 two 26,000,000 and one 30,000,000-gall. pumps have been added. That known as No. 1 was built at the Detroit Locomotive Works, and Nos. 2 and 3 at the Riverside Iron Works, Detroit. The boilers are by 19½ ft., and there are 8 batteries of 4 each. Plans for a new pump, and boilers were made in '88.

Stand-Pipe.—Is 132 ft. high, 5 ft. in diam. at the base and 2½ at the top, the plates decreasing from ⅜ to 3-16 in. in thickness.

Distribution.—*Mains*, c. i., wood, 323 miles. Wooden pipe was laid as late as '81, but at a diminishing rate each year, in '80 but 1½ miles being laid while 2½ miles were replaced with iron pipe. In '81 there were 81¼ miles of 2½ to 4-in. wooden pipe, and of the 124¾ miles of iron pipe then in use 56 miles were 3 and 4-in. in diam. *Services*, lead. *Taps*, 32,938. *Meters*, 44; first used in '76. *Hydrants*, Flower, Galvin, Murdock, 1,569. *Valves*, kind, do.

Consumption, 36,079,166 galls. *Pressure*: 25 lbs.

Financial.—Cost, $4,091,453. Debt, $1,377,000. Int., 4, 6 and 7%. Ann. op. exp., $106,614. Ann. rev.: consumers, $322,835; city, $80,233.

Management.—Commrs. Secy., Henry Stark. Mech. Engr., Jno. E. Edwards. Supt., Henry Bridge.

References.—*To Engineering News*: Regarding new works, especially the pumping machinery, vol. IV., p. 179, and vol. VII., 439; the whole system, vol VIII., p. 194.

EAST SAGINAW, *Saginaw Co.* (Pop., 19,016; est., 32,500.) On east bank of Saginaw river, 16 miles from Lake Michigan, at head of navigation. Manufactures lumber and salt in large quantities. Settled in '50; incorp. a village in '55, a city in '59.

History.—Built in '73 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Saginaw river, from a gravel filter in intake crib, by direct pumping.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Holly quadruplex compound pumps, and horizontal tubular boilers.

Distribution.—*Mains*, c. i., 46 miles. *Services*, w. i., lead. *Taps*, 1,911. *Meters*, Crown, Union, Worthington, 120. *Hydrants*, Holly, Mathews, 266. *Valves*, Galvin, Flower.

Consumption, 2,812,912 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $486,379. Debt, $410,000. Int., 4 to 8%. Ann. op. exp., $15,967. Ann. rev.: consumers, $26,971. City pays interest on debt, $24,955.

The op. exp. for '75 was $12,602, and the rev., $7,393. For '80 the op. exp. was $8,571, and the rev., $9,561.

Management.—Five Commrs. Secy., H. M. Newton. Inspector, Jno. Weller.

EAST TAWAS, *Tosco Co.* (Pop., 712; est., 3,000.) Engaged in lumber and fish industries.

History.—Built in '87-88 by village. Des. Engr., Solon Sawyer. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly-Gaskill duplex pump, and steel boilers.

Distribution.—*Mains*, Wyckoff wood, 7 miles. *Hydrants*, 64.

Pressure: Ordinary, 30 lbs. Fire, 60 to 90 lbs.

Financial.—Cost, $28,000. Bonded debt, $28,000. Int., 6%.

Management.—Not given. Report by Robt. Merrick.

NOTE:—Not finished at time of report.

EDMORE, *Montcalm Co.* (Pop., 704; est., 1,200.) On divide of Lake Huron and Michigan water-sheds. Manufactures lumber. Settled and incorp. in '78.

History.—Built in '81 by village. Engr. and Contr., James Slemons.

Water Supply.—Well 16 ft. in diam. by 32 ft. deep, with 10 2-in. tube wells driven 60 ft. in its bottom, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Dean pumps with 10-in. steam and 6-in. water cylinders of 12-in. stroke, and two 25 H. P. vertical boilers.

Reservoir.—Is 32 ft. in diam. and 12 ft. deep, with 8-in. brick walls, and 6-in. bottom on 2 ft. of concrete. It is 40 ft. above the pumps, and 20 above the village.

Distribution.—*Mains*, w. i., 1 mile. *Services*, w. i. Pipe and specials furnished by National Tube Works Co., McKeesport, Pa. *Taps* 25. *Meters*, none. *Hydrants*, Flower. *Valves*, Flower.

Consumption, 8,000 galls. *Pressure*; Ordinary, 10 lbs. Fire, 140 lbs.

Financial.—Cost, $8,500. No debt. Ann. op. exp., $500. Ann. rev.: consumers $300; city, none.

Management.—Fire Com. of two. Report by Jas. S. Crowns.

ESCANABA, *Delta Co.* (Pop., 3,036; est., 7,000.) On Little Bay de Noquette at the north of Green bay. Engaged in lumber and iron industries.

History.—Built in '87 by Moffett, Hodgkins & Clarke, and called the Escanaba Water-Works Co.

Water Supply.—Green bay, filtered, by direct pumping.

Intake Pipe.—Extends into the bay 2,300 ft.

Filter.—Not described.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington compound pump

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 113. *Meters*, 1. *Hydrants*, Ludlow, 70. *Valves*, Ludlow.

Consumption, 123,677 galls. *Pressure*: Ordinary, 30 lbs. Fire, 150 lbs.

Financial.—Cost, $125,000. Debt, $100,000. Int., 6%. Ann. op. exp., withheld, but est., $2,500. Ann. rev.: consumers, withheld, but est., $4,000; city, $3,500.

Management.—Prest., J. V. Clarke, Watertown, N. Y. Supt., W. H. LaFleun.

EVART, *Osceola Co.* (Pop., 1,302; est., 2,000.) On Muskegon river. Has good water-power, and manufactures lumbering tools. Settled in '74

History.—Built in '79-80 by village. Const. Engr. and Contr., M. Walker, Port Huron.

Water Supply.—Spring, by direct pumping. There are two wells, one 8 and the other 15 by 10 ft. In case of fire water from a creek is turned into the wells.

Pumping Machinery.—Cap., not given; a Walker pump is now used, but formerly there were Dixon & Perkins pumps here.

Distribution.—*Mains*, Wyckoff wood, 2 miles. *Services*, Wyckoff wood, iron. *Taps*, (in '86,) 125. *Meters*, none. *Hydrants*, Holly, 15. *Valves*, Eddy.

Consumption, 25,920 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, about $15,000. No debt. Ann. op. exp., $1,500. Ann. rev.: total, $1,500.

Management.—Chairman of Commrs., D. Richmond. Engr., Edward Scott. Report by W. A. Lewis.

FLINT, *Genesee Co.* (Pop., 8,400; est., 13,000.) On Flint river, which furnishes water-power used in manufacturing.

History.—Built in '83 by Flint City Water-Works Co., under a 30 year's franchise. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Wells, Swartz creek and Thread river, by direct pumping. There is a reservoir, but it is not described.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000-gall. horizontal compound Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, galv. i. *Taps*, 642. *Meters*, 2. *Hydrants*, Holly, 107. *Valves*, Holly.

Consumption, 528,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 120 lbs.

Financial.—Cost, $140,000. Capital stock, $150,000. Int., 6% Bonded debt, $100,000 Ann. op. exp., $6,500. Ann. rev.: consumers, $9,400; city, $7,800.
for first 100, and $50 for additional.

Management.—Prest., Wm. Hamilton. Treas., C. S. Brown. Secy., W. C. Durant.

FORT GRATIOT, *St Clair Co.* (Pop., 1,280; est., 2,400.) Is one mile north of Port Huron. Has railway repair shops.

History.—Built in '86 by village.

Water Supply.—St Clair river, by direct pumping.

Pumping Machinery.—Dy. cap., 750,000 galls.; Walker pumps and 4 by 12-ft steel boilers.

Distribution.—*Mains*, Kalamein i., 6 miles. *Services*, w. i., lead. *Taps*, 244. *Meters*, none. *Hydrants*, Ludlow, 40. *Valves*, Galvin.

Consumption, 75,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 65 to 75 lbs.

Financial.—Cost, $28,000. Debt, $25,000. Int., 5%. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,400; city, none.

Management.—Supt., J. A. McMartin.

FREMONT, *Newaygo Co.* (Pop., 902; est., 1,300.) Has foundry and flouring mills.

History.—Built in '83 by village.

Water Supply.—Springs and four flowing wells, by direct pumping.

Pumping Machinery.—Walker pumps, dy. cap., not given.

Distribution.—*Mains* and *Services*, galv. i., 1 mile. *Taps*, 8. *Meters*, none. *Hydrants*, Holly, 10.

Consumption, 2,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $6,000. No debt. Ann. op. exp., not given. Ann. rev.: consumers, $300.

Management.—Chf. Fire Dept., J. Gerber.

GAYLORD, *Otsego Co.* (Pop., est., 1,200.) Engaged in lumbering.

History.—Built in '88 by village. Engrs. and Contrs., Michigan Pipe Co., Bay City.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Deep well-pump, dy. cap., 100,000 galls.

Tank.—Is 16 by 30 ft.

Distribution.—*Mains*, 4 and 6-in. Wyckoff wood, 2 miles. *Hydrants*, Holly-Gaskill, 18. *Valves*, Galvin. *Pressure*: Ordinary, 30 lbs.

Financial.—Cost, $7,000. Debt, $8,000. Int., 6%.

Management.—Village Prest., F. A. Baldwin.

GLADWIN, *Gladwin Co.* (Pop., 467; est., 1,000.) On Cedar river.

History.—Built in '88 by village; will be put in operation Jan. 1, '89. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich.

Water Supply.—Spring, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000; Gordon & Maxwell pump.

Distribution.—*Mains*, 4 and 8-in. Wyckoff wood, 1 mile. *Hydrants*, Gaskill, 9, *Valves*, Galvin.

Financial.—Cost, $6,000. Debt, 7,000. Int., 7%.

Management.—Village Prest., W. W. Steele. Clerk, Eugene Foster.

GRAND HAVEN, *Ottawa Co.* (Pop., 4,862; est., 6,000.) On Lake Michigan at the mouth of Grand river. Has good harbor, and is a summer resort. Manufactures lumber and leather.

CITY'S WORKS.

History.—Built in '80 and extended in '88 by village.

Water Supply.—Driven wells, and one open well, by direct pumping. A number of 2½-in. wells were driven in four lines radiating from the pump-well. Each pipe, or tube, has a perforated point 6 ft. long, the wells are 32½ ft. deep, and are connected with the pump-well by 4 and 6-in. suction pipes.

Pumping Machinery.—Dy. cap., 500,000 galls.; three Walker pumps with 14-in. steam and 8-in. water cylinders of 12-in. stroke. Tubular boiler.

Distribution.—*Mains*, c. i., Wyckoff wood, 4 miles. *Services*, w. i., galv. i. *Taps*, 150. *Meters*, not given. *Hydrants*, Chapman, Galvin, 37. *Valves*, Chapman, Galvin.

Consumption, 180,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 120 lbs.

Financial.—Cost, $19,000. No debt. Ann. op. exp., (for '86) $1,800. Ann. rev.: consumers, not given, but est., $2,400.

Management.—Supt., A. L. Holmes.

GRAND HAVEN WATER-WORKS CO.

History.—Works built in '84.

Water Supply.—Driven wells, by direct pumping.

Distribution.—*Mains*, Kalamein i., c. i., 7 miles. *Services*, galv. i. *Taps*, 200. *Hydrants*, 60.

Consumption, 75,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $40,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $2,600. Ann. rev.: consumers, $2,200; city, $4,200. Hydrant rental, $70.

Management.—Prest., S. L. Wiley, Omaha, Neb. Secy., T. A. Taylor. Treas. Geo. Stickney.

NOTE:—The figures under Distribution and Financial are for '86.

GRAND RAPIDS *Kent Co.* (Pop., 32,016; est., 60,000.) At head of navigation on Grand river, 30 miles from Lake Michigan. The river here falls 17 ft. in two miles, furnishing good water-power used in manufacturing.

THE HYDRAULIC CO.'S WORKS.

History.—The Grand Rapids Hydraulic Co. first supplied the city with water in '40, and extended their works from time to time until the city built works in '73-5, after which little seems to have been done until '88, when new works were built, the old wooden mains being retained for the former gravity supply.

Water Supply.—Springs and surface well, pumping to stand-pipe. The first supply was from hillside springs, and in '61 a brook formed by springs known as "The Penney Eighty" was drawn upon.

In '64 a reservoir was built near the head of the brook, and in '70 connections made with additional springs.

In '72 a well was sunk to deep gravel strata. It is 30 ft. in diam. and 20 ft. deep, water standing to a depth of 14 ft. It was constructed by building a brick wall, bound with iron, on an iron shoe with a cutting edge, and excavating from the inside, the weight of the wall carrying it down. It was plastered inside and out with gravel so water can enter only from the bottom. A 12-in. suction-pipe connects with the pumps, 150 ft. distant. The supply from springs is still by gravity, through the old wooden pipe.

Pumping Machinery.—Dy. cap., not given; duplex compound condensing low and high-pressure Blake pumps, the latter being held in reserve.

Stand-Pipe.—Cap., 235,000 galls.; 100 ft. high, and about 250 ft. above the river, of steel plate, 5 by 8 ft., by [illegible] in. thick.

Distribution—*Mains*, iron, wood, about 25 miles. The first iron pipe was laid in '57. In '86 there were two miles of wooden logs, and 10 miles of logs covered with iron. No other data given regarding the system.

CITY'S WORKS.

History.—Built in '73 5. Des. Engr., Peter Hogan, Albany. N. Y. Const. Engr., E. W. Muenscher, then City Engr.

Water Supply.—Carrier creek, Cold brook, and from Grand river in case of need, by pumping to reservoir.

Impounding Reservoir.—Built in '75 near the junction of Carrier creek and Cold brook. It has seven sides, varying in length from 33 to 356 ft. The area at the water line is 18.3 acres. It is in excavation and embankment, lined with dry stone, the soil being an impervious clay. A 20-in. cast-iron pipe leads from each stream to the reservoir, at the lower end of which is a masonry dam 50 ft. long, 23 ft. wide and from 3 to 18 ft. high.

Conduit.—Water passes from this reservoir through a channel 4 ft. wide and 32 ft. long, having retaining walls, to an outlet chamber of stone masonry; from this a 20-in. conduit leads to the pump-well, the first 133 ft. being of cast-iron, and the remaining distance of 1,860 ft., pine staves, banded with iron

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two horizontal direct-acting condensing pumps, with 33-in. steam and 14⅝-in. water cylinders, of 72-in. stroke. The pumps were made by Butterworth & Lowe, Grand Rapids. There is one tubular and one marine boiler. The first pump was erected in '75 and duplicated in '79-80. Before the works were finished a temporary fire supply was furnished by an 8½-in. duplex high-pressure Worthington pump.

Distributing Reservoir.—Cap., 6,000,000 galls.; in excavation and embankment, 196 ft. in diam. at the bottom, 271 at the top, 25 ft. deep, with 20 ft. of water. The bank is mostly of sand, with puddle in the center, "along the natural surface," and over the bottom. The bank is 12 ft. wide on top, with an inner slope of 1½ to 1 and an outer of 2 to 1. The inner slope is paved with 1 ft. of cobble stones, laid on 1 ft. of concrete, except the upper 2 ft. of the slope which has 6 in. of cobbles set in gravel. The bottom has an 8-in. cobble stone pavement on 8 in. of concrete. The flow line is 177 ft. above the river. The reservoir has never leaked.

The 16-in. force main and 20-in. effluent pipe are carried under the bank, the joints being enclosed in masonry piers. The force main ends in a mass of masonry, and the effluent pipe begins in a small masonry well, both at the foot of the inner slope.

River Crossing.—About 700 ft. long. A temporary supply was carried over on a bridge in a 6-in. Wyckoff pipe, in a box packed with sawdust. Later a 12-in.

wrought-iron rivetted pipe with spring flanges was laid in a trench by means of sand bags and a coffer dam. It was in 17 lengths of 42 ft. each.

In '86 a 16 in. pipe was substituted for the 12-in. It was furnished by the city, and laid by W. R. Coats, Kalamazoo, the price being $5.50 a foot for the river, and 65 cents for the shore section. A new, or deeper trench, was blasted, 30-in. holes being drilled 2 ft. apart. The pipe was lowered from a trestle of 70 bents, 8 ft. high, the water being 4 to 5 ft. deep. The pipe was put together on the trestle with hemp gasket and lead, and lowered by chain slings 24 ft. apart. Each sling was attached to a 1½-in. screw-rod, 9 ft. long, passing through nuts on special cross-caps. The pipe was lowered in 2½ hours.

Distribution.—*Mains*, wood, iron, 28 miles. *Services*, lead. *Taps*, 1,750. *Meters*, Worthington, Ball & Fitts rotary and piston, Crown duplex, 400. *Hydrants*, Mathews, 296. *Valves*, Eddy.

Consumption, 2,769,333 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $530,000. Debt, $382,000. Int., 8%. Ann. op. exp., $22,481. Ann. rev.: consumers $41,695; city, none.

Management.—City Surveyor, H. A. Collar. Clerk and Collector, Fred. A. Twamley. Pumping Engr., Geo. E. Kirk. Inspector, A. Per Lee.

NOTE:—An extended description of laying the submerged pipe across Grand river was given by W. R. Coats in a paper read before the Michigan Soc. of C. E. in '86, or '87.

GREENVILLE, *Montcalm Co.* (Pop., 3,144; est., 4,000.) On Flat river, 28 miles from Grand Rapids. Has flour, lumber, shingle and planing mills, and barrel factory.

General Description.—It is unofficially reported that works were to be finished in '88. A report from City Clerk Jas. Gracey, made the first of '88, stated that the supply would be from wells, [artesian] that the works would be built by the city at a cost of about $25,000, met by bonds. No further data can be obtained. Address Wm. Backus or L. H. Wright.

HANCOCK, *Houghton Co.* (Pop., 1,783; est., 4,000.) Has copper mines, stamp mill, smelting works and foundry.

History.—Built by village, date not given.

Water Supply.—Springs, by gravity from reservoir.

Reservoir.—Is 20 by 40 ft., by 14 ft. deep, and 200 ft. above village.

Distribution.—*Mains*, 6-in. iron, 2 miles. *Services*, not given. *Taps*, 500. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, unknown. *Pressure*: 200 ft. head.

Financial.—Cost, $8,000. No debt. Ann. op. exp. and rev. is not given, but a tax of ¼%. is levied.

Management.—Seven Trustees. Report by Thos. Smart.

HARRISON, *Clare Co.* (Pop., 129; est., 800.)

History.—Built in '85 by village.

Water Supply.—Budd lake, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap., 403,200 galls.

Distribution.—*Mains*, Wyckoff wood, 1½ miles. *Services*, w. i. *Taps*, 110. *Meters*, none. *Hydrants*, Bailey, 15. *Valves*, Eddy.

Consumption, 55,500 galls. *Pressure*: Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, $8,000. Debt, $3,500. Int., 5%. Ann. op. exp., $1,200. Ann. rev.: consumers, $750; city, none.

Management.—Village Council. Secy., A. H. Hudson.

HASTINGS, *Barry Co.* (Pop., 1,284; est., 3,000.) On Thornapple river, 32 miles from Grand Rapids.

History.—Built in '86-7 by village. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Well, 20 by 30 ft., by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two duplex high-pressure Deane pumps.

Distribution.—*Mains*, 8, 6 and 4-in. c. i., about 5 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, Morgan, 39. *Valves*, Crane.

Consumption, 100,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $27,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $2,200. Ann. rev.: consumers, $1,500; city, none.

Management.—Commrs.; Prest., W. L. Wilkins, Wm. Hayes and Wallace Kelley.

HILLSDALE, *Hillsdale Co.* (Pop., 3,441; est., 4,000.) In undulating country.
History.—Built in '85-6 by village. Engr., J. D. Cook, Toledo, O. Contr. for masonry and buildings, E. C. Campbell.
Water Supply.—Bawbeese lake, by direct pumping.
Pumping Machinery.—Dy. cap., 2,000,000 galls.; Blake pump, and tubular boiler.
Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and trenching and pipe-laying done by M. Philbin, Chicago, Ill. *Taps*, 318. *Meters*, none. *Hydrants*, Flower, 65. *Valves*, Eddy.
Consumption, 224,274 galls. *Pressure*: Ordinary, 45 lbs. Fire, 80 to 130 lbs.
Financial.—Cost, $55,000. Debt, $45,000. Int., 4%. Ann. op. exp., $2,105. Ann. rev.: consumers, $2,000; city, none.
Management.—Chairman Comm., G. H. McDermid.

HOLLAND, *Ottawa Co.* (Pop., 2,620; est., 3,500.) On Macatawa bay, 25 miles from Grand Rapids. Engaged in lumbering, tanning, and manufacturing flour.
History.—Built in '85 by village. Engr., M. Walker, Pt. Huron.
Water Supply.—Springs, by direct pumping from collecting reservoirs.
Reservoirs.—One 12 and one 16 ft. in diam., each 16 ft. deep.
Pumping Machinery.—Dy. cap., 1,500,000 galls.; two direct-acting Walker pumps, and two horizontal tubular boilers, each 4 by 12 ft.
Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i., lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and trenching and pipe-laying done by Alba L. Holmes, Grand Rapids. *Taps*, 107. *Meters*, none. *Hydrants*, Ludlow, 39. *Gates and boxes*, Galvin.
Consumption, 100,000 galls. *Pressure*: Ordinary, 38 lbs. Fire, 100 lbs.
Financial.—Cost, $28,268. Debt, $23,600. Int., 5%. Ann. op. exp., $2,393. Ann. rev., consumers, $1,263; city, money is raised by general taxation to meet the balance of expenses.
Management.—Commrs. Supt. and City Clerk, Geo. H. Sipp.

HOLLY, *Oakland Co.* (Pop., 1,443; est., 1,500.) On Shiawassee river.
History.—Built in '79 by village. Const. Engr. and Contr., M. Walker, Pt. Huron.
Water Supply.—Shiawassee river, by direct pumping.
Intake Pipe.—Is 8 in. in diam. and 359 ft. long.
Pumping Machinery.—Two Walker pumps of 14-in. steam and 7½ in. water cylinders of 12-in. stroke were erected when the works were built.
Distribution.—*Mains*, 4 and 8-in. Wyckoff wood, 3½ miles. *Services*, not given. *Taps* and *Meters*, not given. *Hydrants*, Galvin, 17. *Valves*, Galvin.
Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.
Financial.—Cost, $10,000. Debt, $2,000. Int. 5%. Ann. op. exp., $1,100. Ann. rev.: consumers, $1,300, of which $900 is from railway companies.
Management.—Supt., Jos. Bennett. Clerk, C. H. Baird.

IONIA, *Ionia Co.* (Pop., 4,190; est., 5,000.) Is ¾ miles from Grand river on level ground at the foot of a bluff. Settled in '42; incorp. in '75.
History.—Built in '76 by village. Des. Engrs., Geo. Briggs and Jas. Bell.
Water Supply.—Springs and surface water, by direct pumping. The springs are on a hill within the village limits, and water passes from them through marshy ground for about ¼ of a mile to the reservoir.
Reservoir.—Wooden, 30 ft. in diam., and 44 ft. above village.
Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile pump, and marine boilers.
Distribution.—*Mains*, c. i., Kalamein i., wood, 12 miles. *Services*, galv. i., lead. Pipe and specials furnished by the Michigan Pipe Co., Bay City, and the Lake Shore Foundry, Cleveland, O. *Taps*, 550. *Meters*, none. *Hydrants*, Holly, Flower, Ludlow, Mathews, Galvin, 99.
Consumption, 300,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 105 lbs.
Financial.—Cost, $98,000. Debt, $3,000. Int., 5%. Ann. op. exp., $1,600. Ann. rev.: consumers, $3,700; city, none.

Management.—Supt., Frank C. Sibley.

ISHPEMING, *Marquette Co.* (Pop., 6,039; est., 10,000.) **Engaged in mining.**

History.—Built in '82 by city.

Water Supply.—Lake Angeline, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington pumps, and two tubular boilers, each 5 by 15 ft.

Distribution.—*Mains*, Wyckoff wood, 9.2 miles. *Services*, galv. i. *Meters*, none. *Hydrants*, kind not given, 54.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 95 lbs.

Financial.—Cost, $70,000. Debt, $45,000. Int., 5%. Ann. op. exp., $6,292. Ann. rev.: consumers, $8,383; city, none.

Management.—Water Board of three; P. T. Divine, H. H. Mildare and C. H. Hall, who acts as Supt. and made report.

ITHICA, *Gratiot Co.* (Pop., 600; est., 2,000.)

General Description.—The village sunk a well 700 ft. in '84, and pump water to a tank at an elevation of 20 ft., from which water is distributed to cisterns for fire protection and to a few factories. There is less than a mile of pipe, and 7 or 8 taps. What has been done already has cost about $1,000. There is no debt. The Marshall is paid $360 a year for operating the works.

There is talk of putting in a complete system, but the present well will not furnish a suitable supply. Report by Jas. P. Gibbs.

JACKSON, *Jackson Co.* (Pop., 16,105; est., 24,000.) On both sides of Grand river. Manufactures machinery, paper, and various other things. Settled in '29; incorp. a village in '43, a city in '57.

History.—Built in '70 by private company and bought by city in '71. Des. Engr. B. Holly, Lockport, N. Y. Const. Engr., Wm. Bennett, Jackson. Contr. for masonry and buildings, Hugh Richards.

Water Supply.—Artesian wells, by direct pumping. The first two wells are 6 in. in diam. by 203 ft. deep, and in '81 a 10-in. well was begun.

Pumping Machinery.-Dy. cap., 6,000,000 galls.; Holly-Gaskill pumps, and horizontal tubular boilers. At first two rotary Holly pumps were used, and in '72 two 10-in. piston pumps of 27-in. stroke were added.

Distribution.—*Mains*, c. i., 21 miles. *Services*, w. i., lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., and pipe-laying done by city. *Taps*, 3,000. *Meters*, 30. *Hydrants*, Holly, 218. *Valves*, Holly. *Presure gauge*, Edson.

Consumption, 180,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $250,000. Debt, $160,000. Int., 6 and 8%. Ann. op. exp., $10,000 Ann. rev.: consumers, $18,000; city, none.

In '80 the op. exp., were $7,000, and the rev., $8,251.

Management.—Supt., Benj. Porter.

KALAMAZOO, *Kalamazoo Co.* (Pop., 11,937; est., 22,000.) On Kalamazoo river. Has various manufactories.

History.—Built in '69 by city. Des. Engr., Birdsall Holly, Lockport, N. Y. No Const. Engr., or Contr. for labor.

In '60 Geo. Bales contracted to pump water for fire protection, and before this water for the same purpose had been taken from the Michigan Central R. R. Co.'s tank, the waste flowing to a cistern at the court house.

Water Supply.—Two surface wells, by direct pumping. The first well is 24 ft. in diam., and when finished water stood in it 24 ft. deep. The wall was built on a cast-iron shoe, with a cutting edge, and sunk by excavating from the inside, through 14 ft. of fine sand into a porous gravel. A second well was sunk in '87, under the direction of W. R. Coats, Kalamazoo.

The supply in '69 was taken from a well sunk near and 7 ft. lower than Axtell's brook, but the water being impure this well was abandoned.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly-Gaskill and Worthington.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i., lead. Pipe and specials furnished R. D. Wood & Co., Philadelphia, Pa., Dennis Long & Co., Louisville, Ky., and Lake Shore Foundry, Cleveland, O. *Taps*, about 1,200. *Meters*, 7. *Hydrants*, Holly, Ludlow, 203. *Valves*, Holly, Ludlow.

Consumption, 1,526,294 galls. *Pressure*: Ordinary, 45 lbs. Fire, 88 lbs.

Financial.—Cost, $322,817. Debt, none. Ann. op. exp., $9,732. Ann. rev.: consumers, $13,773; city, none.

Management.—Chf. Engr. and Supt., Geo. H. Chandler.

LAKE CITY, *Missaukee Co.* (Pop., est., 700.) On Lake Muskat. Engaged in farming and lumbering.

History.—Built in '88 by Daniel Reeder & Co. Engr., H. H. Greene, Cadillac. The village has contracted for hydrants for five years, with privilege of buying works at the end of that time.

Water Supply.—Lake Muskat, by direct pumping.

Pumping Machinery.—Davidson pump, dy. cap., 1,000,000 galls.; boilers furnished by W. Hayes, Cadillac.

Distribution.—*Mains*, 4 and 6-in. Wyckoff wood, 1 mile; furnished by the Michigan Pipe Co., Bay City. *Taps*, 75. *Hydrants*, Galvin, 6. *Valves*, Ludlow.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $5,000. Capital stock, $5,000. No debt. Hydrant rental, $100.

Management.—D. Reeder.

NOTE:—Other data not determined.

LAKE LINDEN, *Houghton Co.* (Pop., 2,610; est., 3,000.) Engaged in lumbering, copper mining and stamping.

History.—Built in '87 by village, Des. Engr., Jas. P. Edwards. Labor done by the day.

Water Supply.—Artesian well and creek, by direct pumping from former for domestic use, and by gravity from latter for fire protection.

Reservoir.—Is 60 by 80 ft., by 16 ft. deep.

Pumping Machinery.—Dy. cap., 35,000 galls.; furnished by Gray Bros.

Distribution.—*Mains*, iron, 2½ miles. *Services*, not given. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 33.

Consumption, 35,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Bonded debt. $10,000. Int., 6%. Ann. op. exp., not given. Ann. rev.: consumers, $1,500; city, $2,400.

Management.—Secy., D. W. Sutton. Supt., L Deschamps.

LANSING, *Ingham Co,* (Pop., 8.319 est., 12,000.) On Grand river, which furnishes water-power used in manufacturing.

History.—Built in '86 by city. Des. Engr., Chester B. Davis, Chicago, Ill. Const. Engrs., Meyers & Son. No Contrs. for labor except for pipe-laying.

Water Supply.—Eight tile-lined wells, 34 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington pumps, and two tubular boilers.

Stand-Pipe.—Is 18 ft. in diam. by 152 ft. high; Contrs., Lansing Iron & Engine Works.

Distribution.—*Mains*, c. i., 17½ miles. *Services*, lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., and trenching and pipe laying done by Meyers & Son. *Taps*, 600. *Meters*, 15. *Hydrants*, Ludlow, 179. *Valves*, Ludlow.

Consumption, 800,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 65 lbs.

Financial—Cost, $135,000. Debt, $100,000. Int., 4½%. Ann. op. exp., $1,000. Ann. rev.: consumers, $7,300; city, none.

Management.—Board of five. Prest., Alfred Wise. Supt., W. S. Wright.

LAPEER, *Lapeer Co.* (Pop., 2,911; est., 3,000.)

History.—Built in '88 by village. Engr. and Contr., M. Walker, Port Huron.

Water Supply.—Three flowing artesian wells, about 180 ft. deep, by direct pumping. The overflow from the wells goes to a small reservoir, for a reserve in case of fire.

Reservoir.—Cap., 30,000 galls.

Pumping Machinery.—Walker pump; dy. cap., 1,500,000 galls.

Distribution.—*Mains*, 10 to 4 in. c. i., 2-in. Kalamein i., 10½ miles; 7 of the former and 3½ of the latter. *Services*, lead, Kalamein i. *Taps*, 102. *Meters*, none. *Hydrants*, Ludlow, 70. *Valves*, Eddy.

Consumption, 65,000 galls. *Pressure*: Ordinary, 38 lbs. Fire, 95 to 100 lbs.

Financial.—Cost, $41,000. Bonded debt, $40,000. Int., 5%. Other data not determined.

Management.—Five Commrs. Prest., J. B. Moore.

LOWELL, *Kent Co.* (Pop., 1,538; est., 2,500.) On Grand river, 18 miles from Grand Rapids.

History.—Built in '87, and put in operation Jan., '88, by Lowell Water Co. Engr., A. C. Sekell, all labor being done by the day under his direction.

Water Supply.—Twenty driven wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Smith & Vaile duplex high-pressure pump, and 40 H. P. vertical boiler.

Reservoir.—Is 34 ft. in diam. and water stands 8 ft. deep.

Distribution.—*Mains*, c. i., 3⅜ miles. *Services*, lead, iron. Pipe and specials furnished by Detroit Pipe & Foundry Co. *Meters*, none. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Pressure, Fire and Ordinary, 65 lbs.

Financial.—Cost, about $22,000. Capital stock, $30,000. Authorized bonds, $30,000. Int., not given. Hydrant rental, $50.

Management.—Prest., Edwin F. Sweet. V. Prest., E. W. Withey. Secy., Edgar W. Ford. Treas., Jno. E. More. Supt. and Mgr., A. C. Sekell.

LUDINGTON, *Mason Co.* (Pop., 4,190; est., 7,000.) On Lake Michigan at mouth of Pere Marquette river. Engaged in lumber trade, and has salt and iron works. Settled in '67; incorp. a city in '73.

History.—Built by Ludington Water Co. in '82. Contr., M. Walker, Pt. Huron.

Water Supply.—Lake Michigan and Pere Marquette river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Walker pumps of 7-in. bore and 14-in. stroke.

Distribution.—*Mains*, Wyckoff wood, 6½ miles. *Services*, w. i., lead. *Taps*, 230. *Meters*, none. *Hydrants*, Holly, Galvin, 80.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $55,000. No debt. Ann. op. exp., $3,500. Ann. rev.: consumers, $4,500; city, $5,520. Hydrant rental, $80.

Management.—Prest., Thos. R. Lyon. Secy., F. P. Dunwell. Supt., N. J. Gaylord.

LYONS, *Ionia Co.* (Pop., 747; est., 800.) On Maple river. Has water-power. Manufactures windmills.

History.—Built in '79 by village for fire protection and street sprinkling. No Engr.

Water Supply.—Maple river, by direct pumping.

Pumping Machinery.—Holly water-power pump, dy. cap., 324,000 galls.

Distribution.—*Mains*, Wyckoff wood, 0.3 miles. *Hydrants*, Holly, 7.

Pressure: 100 lbs.

Financial.—Cost, $3,000. No debt. Ann. op. exp., $50. No rev.

Management.—Prest., Jno. McQuillin. Supt., J. W. Rudgers.

MANISTEE, *Manistee Co.* (Pop., 6,930; est., 13,000.) On Lake Michigan at the mouth of Manistee river. Manufactures shingles, salt and lumber.

History.—Built in '82-3 by Manistee Water Co. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Combined surface and driven wells, by direct pumping. The surface well is 30 ft. in diam. and depth, and in its bottom are two wells 100 ft. deep, and 2 and 4 in. in diam. respectively. A pipe has been laid to connect with the Manistee river.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Holly quadruplex pump of 14-in. bore and 25-in. stroke. There has also been connected with the works two 8-in. Holly pumps of 12-in. stroke.

Distribution.—*Mains*, c. i., 18 miles. *Services*, galv. i., lead. *Taps*, 800. *Meters*, none. *Hydrants*, Holly, 81. *Valves*, Ludlow, Eddy, Galvin.

Consumption, 650,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 85 to 140 lbs.

Financial.—Cost, $188,000. Capital stock, $120,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $7,000; city, $8,200. Hydrant rental, $100, 20 years' contract.

Management.—Prest., E. D. Wheeler. Secy., G. A. Hart. Treas., T. J. Ramsdell. upt., S. A. Cahill.

MARINE CITY, *St. Clair Co.* (Pop., 1,673; est., 3,000.) On St. Clair river, 20 miles from Pt. Huron. Engaged in manufacturing salt, brick, barrels, and in building boats.

History.—Built in '84 by town. All labor done by the day.

Water Supply.—St. Clair river, by direct pumping.

Pumping Machinery.—Dy. cap., not given.; Walker pumps and two steel tubular boilers.

Distribution.—*Mains*, c. i., 5 miles. *Services*, not given. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 300. *Meters*, none. *Hydrants*, Bailey, 36. *Valves*, Galvin.

Consumption, 71,253 galls. *Pressure*: Ordinary, 25 lbs. Fire, 80 lbs.

Financial.—Cost, $32,000. Debt, $32,000. Int., 6%. Ann. op. exp., $2,200. Ann. rev.: consumers, $2,600; city, none.

Management.—Commrs. act as Supt. Report by E. M. Clark.

MARQUETTE, *Marquette Co.* (Pop., 4,690; est., 8,000.) On Lake Superior, on a bluff 25 ft. above the water. Has iron mines, blast furnaces, rolling and powder mills.

History.—Built in '70 by town. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Lake Superior, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; double acting plunger pumps. There have been connected with the works a gang of six single-acting 6-in. bucket pumps, with a rotary pump for fire protection, also a gang of eight 12-in. double-acting bucket and plunger pumps of 12-in. bore and stroke.

The cylinders of the engine driving the former were 14 in. in diam. with 24-in. stroke, and of the latter 18 in. in diam. with 24-in. stroke.

Distribution.—*Mains*, c. i., 11½ miles. *Services*, galv. i. *Taps*, 850. *Meters*, 2. *Hydrants*, Holly, Galvin, 99. *Valves*, Ludlow, Galvin.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $171,000. Debt, $75,000. Int., 7, 6 and 5 %. Ann. op. exp., $7,500. Ann. rev.: consumers, $14,000; city, none.

Management.—Prest. and Treas., J. M. Wilkinson. Supt., J. Kern.

MENOMINEE, *Menominee Co.* (Pop., 3,010; est., 7,000.) On low, sandy ground at mouth of Menominee river, which empties into Green bay, Lake Michigan. A considerable portion of the city is on land made by filling in with sawdust and slabs. Manufactures lumber. Settled in '22; incorp. a city in '83.

History.—Built in '84 by Menominee Water Co. Engrs., H. F. Dunham, and O. Burlingame, the latter of Menominee. Contr., A. H. Howland, Boston, Mass.

Water Supply.—Green bay, by direct pumping.

Intake Pipe.—Consists of 1,000 ft. of 12, and 25 ft. of 8-in. pipe, connecting with pump-well

Pumping Machinery.—Dy. cap., 2,500,000 galls.; one high and one low-pressure compound condensing Deane pump.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., galv. i., lead. Pipe and specials furnished by Lake Shore Foundry, Cleveland, O. *Taps*, 550. *Meters*, 1. *Hydrants*, Chapman, 163. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $125,000. Capital stock, (in '86,) $200,000. Bonded debt, (in '86,) $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $6,760; city, $9,480. Hydrant rental, $75 for first 60, and $60 for additional. There are 21 private hydrants at $60.

Management.—Prest., A. H. Howland, Boston, Mass. Supt., W. E. Mabury.

MIDLAND, *Midland Co.* (Pop., 1,529; est., 3,000.) On Tittebawasee and Chippewa rivers, on high ground, 20 miles from Saginaw. Manufactures lumber, salt and bromine. Settled in '55; incorp. a city in '68.

History.—Built in '82 by city. Engr., M. Walker, Pt. Huron.

Water Supply.—Chippewa river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Walker pumps, and steel tubular boilers.

Distribution.—*Mains*, Wyckoff wood, 4 miles. *Services*, w. i., lead, wood. *Taps*, 140. *Meters*, none. *Hydrants*, Holly, 132

Consumption, 300,800 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $21,000 Debt, $20,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,602; city, none.

Management.—Secy. Water Board and Supt., Wm. Reardon.

MOUNT CLEMENS, *Macomb Co.* (Pop., est., 4,500.) On Clinton river, at head of navigation, 25 miles from Detroit. Has mineral springs.

General Description.—Built in '88. Des. Engr., Chester B. Davis, Chicago, Ill. Const. Engr., J. F. Whitmer. It is unofficially reported that the supply is filtered by a plant put in by the American Filtering Co., Chicago; that there are 7 miles of pipe and 107 hydrants. Prest. of Commrs., G. W. Robertson. Clerk, Chas. A. Fitch.

MOUNT PLEASANT, *Isabella Co.* (Pop., 1,115; est., 3,000.) On Chippewa river on gently sloping ground about 20 ft. above the river. The soil is sandy, underlaid by hardpan at a depth of about 8 ft. Settled in '64; incorp. in '65.

History.—Built in '82-3 by village. Des. Engr., A. C. Sekell, Grand Rapids. All work done by the day.

Water Supply.—Well, pumping to tank and, in case of fire, direct. The well is 17½ ft. in diam. for 20 ft., then 6 ft. in diam. for 8 ft., and in its bottom there are one 6, two 3 and one 2-in. driven wells. Less than half the population is now supplied.

Pumping Machinery.—Dy. cap., not given; Deane water-power pump, of 16-in. bore and stroke, forcing water through an 8-in. c. i. main to tank.

Tank.—Of cedar, 20 ft. in diam., 16 ft. deep, 75 ft. above the pumps and 45 above the highest part of the village.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i., lead. Mains and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and lead and lead pipe by Detroit Lead Pipe and Sheet Lead Works. *Taps*, 172. *Hydrants*, Ludlow, one Galvin, 24. *Valves*, Galvin, Ludlow.

Consumption, 140,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $45,000. Debt, $15,000. Int., 5%. Ann. op. exp., $1,575. Ann. rev.: consumers, $1,593; city, none. Expect to have hydrant rental.

Management.—Three Commrs. Prest., Jno. Kinney. Secy. C. W. Churchill. Treas., Wm. Bamber, Supt., Wm. Dixon.

MUSKEGON, *Muskegon Co.* (Pop., 11,262: est., 25,000.) On Muskegon river, 6 miles from Lake Michigan. Has extensive lumber industries, hardware and machine shops, boiler works and furniture factories.

History.—Built in '74-5 by city. Engr., Geo. C. Morgan, Chicago.

Water Supply.—Well and branch of Muskegon river, by direct pumping. The well is 30 ft. in diam. and 15 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls., two Flanders, two Walker and two Wolverine pumps.

Distribution.—*Mains*, c. i., w. i., 25 miles. *Services*, galv. i. *Taps*, 1,300. *Meters*, none. *Hydrants*, Ludlow, Galvin, 280. *Valves*, Ludlow, Galvin.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 85 lbs.

Financial.—Cost, $208,000. Debt, $130,000. Int., 10%. Ann. op. exp., $13,750. Ann. rev.: consumers, $14,200; city, $15,225.

Management.—Supt., Wm. Dixon.

NEGAUNEE, *Marquette Co.* (Pop., 3,931; est., 6,000.) Engaged in iron mining.

History.—Built in '82-3 by city.

Water Supply.—Teal lake, by direct pumping.

Pumping Machinery.—Dy. cap., about 800,000 galls.; two Worthington pumps, and two 4 by 16-ft. tubular boilers.

Distribution.—*Mains*, Wyckoff wood, 8 miles. *Services*, galv. i. *Taps*, 243. *Meters*, none. *Hydrants*, Holly, 27.

Consumption, 324,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 60 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 4½ and 5%. Ann. op. exp., $4,620 Ann. rev.: consumers, $4,675; city, none.

Management.—Mayor and Common Council. Supt., A. Benishek.

NEWAYGO, *Newaygo Co.* (Pop., 1,097; est., 2,005.) On Muskegon river, which furnishes water-power. Engaged in lumbering and manufacturing.

History.—Built in '84 by village. Engr., M. Walker, Pt. Huron.

Water Supply.—Well, by direct pumping.

Pumping Machinery.—Walker pump; dy. cap., not given.

Distribution.—*Mains*, Wyckoff wood, 1¼ miles. *Services*, galv. i. *Taps*, (in '86,) 24. *Meters*, none. *Hydrants*, Ludlow, 13. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, $12,000. Debt, $10,000. Int., 6%. Ann. op. exp.(in '86)$395. Ann. rev.: consumers, (in '86), $242; city, none.

Management.—Common Council and Village Prest. Supt., Wm. Bierbower.

NILES, *Berrien Co.* (Pop., 4,197; est., 4,500.) On St. Joseph river on undulating ground. Has water-power and manufactories. Settled in '28; incorp. a village in '38.

History.—Built in '78-9 by Niles Water-Works Co. Contr., S. L. Wiley, Omaha, Neb.

Water Supply.—Barren Lake, by gravity to distributing reservoir.

Conduit.—From lake to reservoir, about 5 miles of 12-in. wrought-iron and cement pipe.

Reservoir.—Cap., 300,000 galls.; 106 ft. above village.

Distribution.—*Mains*, w. i. and cement, 9 miles. *Services*, galv. i. *Taps*, 300. *Meters*, none. *Hydrants*, Flower, 50.

Consumption, about 275,000 galls. *Pressure*: 45 lbs.

Financial.—Cost, in '84, $45,000. Further data withheld, but est.: Ann. op. exp., $1,000. Ann. rev.: consumers, $6,000.

The city annulled its hydrant contract, which was $50 for each, but it was hoped that a new one would be made in '88.

Management.—Prest., S. L. Wiley, Omaha, Neb. Supt., Secy. and Treas., J. H. Richardson.

NORTH MUSKEGON, *Muskegon Co.* (Pop., not given, but small.) On Muskegon river, opposite Muskegon.

History.—Built in '85-6 by village. Engr., M. Walker, Pt. Huron. Contr., A. L. Holmes, Grand Haven.

Water Supply.—Rain lake and 30 2-in. driven wells, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap., 500,000 galls.

Distribution.—*Mains*, Wyckoff wood, 6 miles, *Services*, iron. Pipe furnished by Michigan Pipe Co., Bay City, Mich. *Taps*, 125. *Meters*, none. *Hydrants*, kind not given, 48.

Consumption, 350,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $40,000. Debt, $25,000. Int., not given. Ann. op. exp., withheld, but est., $2,500. Ann. rev.: consumers, withheld, but est., $3,000.

Management.—Commr., Supt., Joel S. Davidson.

OSCODA, *Iosco Co.* (Pop., 1,951; est., 7,000.) On Lake Huron, at mouth of Au Sable river. Engaged in manufacturing salt and lumbering.

History.—Built in '86 by village, Engr., H. N. Hewlett, the present Supt.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Blake pumps with 20-in. steam and 12-in. water cylinders of 24-in. stroke. Two private pumps are also connected with with the system, and can be used for fire protection while mills are running. One is a duplex Worthington pump of 12-in. steam and 7-in. water cylinders of 14-in. stroke, and the other a Blake pump of 16-in. steam and 18-in. water-cylinder of 18-in. stroke.

Distribution.—*Mains*, Wyckoff wood, 4 miles. *Services*, Wyckoff wood. Pipe and specials furnished and laid by Michigan Pipe Works, Bay City, Mich. *Taps*, 100. *Meters*, none. *Hydrants*, Holly, Gaskill, 60. *Valves*, Eddy.

Consumption, 250,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $20,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $600. The balance of expense is made up by the city by taxation.

Management.—Village Board. Supt., H. N. Hewlett.

OVID, *Clinton Co.* (Pop., 1,479; est., 2,000.) Engaged in manufacturing.

History.—Built in '88 by village, Engrs., Michigan Pipe Co., Bay City.

Water Supply.—Wells, by direct pumping.

Pumping Machinery.—Gordon & Maxwell pump, dy. cap., 1,500,000 galls.

Distribution.—*Mains*, Wyckoff wood, 3½ miles. *Services*, Wyckoff wood. *Hydrants*, Holly, Gaskill, 32. *Valves*, Galvin.

Financial.—Cost, $15,000.

Management.—Mayor, —— Burroughs.

No other data given.

PETOSKEY, *Emmet Co.* (Pop., 1,815; est., 3,500.) On Bear river and Little Traverse bay, Lake Michigan. Manufactures lime, leather and woodenware.

History.—Built in '81 by village. Des. Engr., W. R. Coats, Kalamazoo.

Water Supply.—Well, 50 ft. from Traverse bay, pumping direct, and to tank for fire protection.

Pumping Machinery.—Dy. cap., 200,000 galls.; Knowles water-power pump of 12-in. bore and 24-in. stroke.

Tank.—Cap., about 160,000 galls.; iron, on high ground at east end of village, 210 ft. above pumps.

Distribution.—*Mains*, c. i., wood, 1¾ miles. *Services*, iron. *Taps*, 150. *Meters*, none. *Hydrants*, Mathews, Holly, 14.

Consumption, 160,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 70 lbs.

Financial.—Cost, original, $21,000. Debt, $16,000. Int., 5%. Ann. op. exp., $700. Ann. rev.: consumers, $1,500; city, none.

Management.—Supt., G. S. Richmond.

PINCONNING, *Bay Co.* (Pop., 738; est., 1,200.) Is 19 miles from Bay City.

History.—Built in '88, and to be put in operation Jan. 1, '89, by village. Engrs. and Contrs., Michigan Pipe Co., Bay City, Mich., they being represented by J. Harling as Des., and J. E. Jackson, Const. Engr.

Water Supply.—Artesian well, by direct pumping.

Pumping Machinery.—Smith & Vaile pump, dy. cap., 1,000,000 galls.

Distribution.—*Mains*, 8 to 4-in. Wyckoff wood, 1½ miles. *Hydrants*, Holly-Gaskill, 16. *Valves*, Galvin.

Financial.—Cost, $7,000. Debt, $7,000. Int., 7%.

Management.—Supt., D. McDougal.

No other data given.

PLAINWELL, *Allegan Co.* (Pop., 1,356; est., 1,800.) On Kalamazoo river, on nearly level ground. Has water-power used in manufacturing flour, paper and woodenware. Settled in '60; incorp. in '68.

History.—Built in '70, and extended in '85, by village.

Water Supply.—Kalamazoo river, by direct pumping.

Pumping Machinery.—Dy. cap., not given; a Holly rotary pump was replaced in '88 by a larger Walker pump.

Distribution.—*Mains*, c. i., Wyckoff wood, 3 miles. *Services*, w. i. *Taps*, 75. *Meters*, none. *Hydrants*, Holly, 21. *Valves*, Holly.

Consumption, not given. *Pressure*, Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, not given, but est., $10,000. No debt. Ann. op. exp., $175. Ann. rev.: total, $375.

Management.—Supt., J. M. Sternberg.

PONTIAC, *Oakland Co.* (Pop., 4,509; est., 6,000.) On Clinton river 26 miles from Detroit.

History.—Built in '88 by town. Des. Engr., J. D. Cook, Toledo, O. Const. Engr. Harvey E. Monroe. Contrs., W. S. Parker & Co., New York City.

Water Supply.—Clinton river and wells, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. compound duplex non-condensing Worthington pumps.

Distribution.—*Mains*, 4 to 16-in. c. i., 13 miles. *Services*, lead, iron. Pipe and specials from New Philadelphia (O.) Pipe Works. *Taps*, 30, adding more. *Meters*, none yet. *Hydrants*, Mathews, 114. *Valves*, Ludlow.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $85,000. Bonded debt, $85,000. Int., 4½%.

Management.—Commrs. Chairman, Jno. D. Norton. Supt., Harvey G. Monroe.

PORT HURON, *St. Clair Co.* (Pop., 8,883; est., 13,500.) At junction of St Clair and Black rivers, one mile from Lake Huron. Engaged in lumbering, shipbuilding and commerce. Settled in '28; incorp. a city in '59.

History.—Built in '72 by city. Des. Engr., Wm. H. Avery.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; a 3,000,000 and a 5,000,000-gall. Holly-Gaskill pump. A small Perkins pump has been used.

Distribution.—*Mains*, c. i., Wyckoff wood, 27½ miles. *Services*, w. i., lead. *Taps*, 1,818. *Meters*, 2. *Hydrants*, Holly, 136. *Valves*, Flower.

Consumption, 1,672,095 galls. *Pressure*: Ordinary, 30 lbs. Fire, 78 lbs.

Financial.—Cost, $222,751. Debt, $120,000. Int., 5%. Ann. op. exp., $9,256. Ann. rev.: consumers, $19,056; city, none.

Management.—Three Commrs. Chf. Engr., Wm. H. Avery. Secy., Lewis Avery.

PORTLAND, *Ionia Co.* (Pop., 1,670; est., 2,500.) At junction of Grand and Looking Glass river. Has water-power and manufactories.

General Description.—Built in '79 by village. A line of Wyckoff wood pipe is laid through the business street for about 1,200 ft., on which there are three hydrants. A pump is used for fire protection, giving a pressure of 80 lbs. There is talk of a new and complete system. Village Trustee, W. F. Selleck.

QUINNESEC, *Menominee Co.* (Pop., est., 500.)

General Description.—Built in '84 by town. A Knowles pump lifts water from a mine to two tanks, from which about a mile of Wyckoff wood pipe distributes it. There ars two taps and five hydrants. Cost, $2,500. No debt. Ann. op. exp., $200. No revenue. Supervisor, Thos. McKenna.

REED CITY, *Osceola Co.* (Pop., 1,091; est., 2,500.) On Hersey river on rolling ground. Has water-power, planing mills and foundries and manufactures flour, furniture, brick, stoves, broom-handles, saws and woolen goods. Settled in '72; incorp. in '75.

History.—Built in '82 by village. Engrs. and Contrs., E. G. Studley & Co., Grand Rapids.

Water Supply.—Well, 20 ft. in diam., spring and Hersey creek, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane pump.

Distribution.—*Mains*, Wyckoff wood, 2 miles. *Services*, w. i. Pipe and specials furnished and laid by Michigan Pipe Co., Bay City. *Taps*, 134. *Meters*, none. *Hydrants*, kind not given, 17.

Consumption, 200,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $12,000. Bonded debt, $6,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,200; city, $300.

Management.—Commrs. Clerk, L. B. Weiner.

ROSCOMMON, *Roscommon Co.* (Pop., 114; est., 500.)

History.—Built in '83 by town. Engrs. and Contrs., Flint, Walling & Co., Kendallville, Ind.

Water Supply.—Spring creek, pumping to tank.

Pumping Machinery.—Dy. cap., not given; two Deane pumps, one of which is direct-acting, and driven by windmill.

Tank.—Of wood, 22 ft. in diam. and 16 ft. high.

Distribution.—*Mains*, Wyckoff wood, 1 mile; furnished by Michigan Pipe Co., Bay City, Mich. *Services*, iron. *Taps*, 25. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 10,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 40 lbs.

Financial.—Cost, $7,500. No debt. Ann. op. exp., $200. Ann. rev.: consumers, $75; city, $125.

Management.—Comm. of three. Supt., Jno. R. Cady. Report by H. H. Woodruff, one of the Com.

SAGINAW, *Saginaw Co.* (Pop., 10,525; est., 18,000.) On Saginaw river at head of navigation, and 22 miles from its mouth. On level ground. Engaged in lumber and salt trade. Settled in '22; incorp., a city in '57.

History.—Built in '72 by city. Des. Engrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Saginaw river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Holly pumps there being 4 piston pumps of 9-in. bore and 24-in. stroke, and two 10-in. rotary pumps for fire pressure.

Distribution.—*Mains*, c. i., Wyckoff wood, 15.6 miles. *Services*, w. i., lead. *Taps*, 370. *Meters*, none. *Hydrants*, Holly, 199. *Valves*, Galvin.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 95 lbs.

Financial.—Cost, $205,000. Debt, $135,000: $70,000 at 8, $40,000 at 4½ and $25,000 at 5½%. Ann. op. exp., $7,000. Ann. rev.: consumers, $5,000; city, $7,000.

Management.—Water Board. Prest., A. W. Orchard. Secy. and Controller, Wm. Binder.

SAINT CLAIR, *St. Clair Co.* (Pop., 1,923; est., 3,200.) At junction of St. Clair and Pine rivers. Has manufactories.

History.—Built in '86 by village.

Water Supply.—St. Clair river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Walker pumps.

Distribution.—*Mains*, Kalamein i., 6¾ miles. *Services*, galv. i. *Taps*, 221. *Meters*, none. *Hydrants*, Ludlow, 46. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $32,500. Bonded debt, $32,500. Int., 5½%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,100; city, none.

Management.—Prest. Water Board, Thos. J. Milliken. Secy. and Supt., W. B. Morse.

SAINT LOUIS, *Gratiot Co.* (Pop., 1,975; est., 3,600.) On Pine river, 30 miles west of Saginaw. Has water-power. Settled in '58; incorp. in '70.

History.—Built in '80 by village. Des. Engr., Jno. T. Noble, St. Louis. Const. Engr., M. Walker, Pt. Huron. Labor on masonry and buildings done by village.

Water Supply.—Two flowing wells, by direct pumping. Water was formerly taken from Pine river.

Reservoir.—Is 30 ft. wide and 16 ft. deep. Depth not given.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; one Walker and two Holly water-power pumps.

Distribution.—*Mains*, Wyckoff wood, about 5 miles. *Services*, Wyckoff wood, lead, w. i. Pipe furnished by Michigan Pipe Co., Bay City, and laid by M. Walker, Pt. Huron. *Taps*, 117. *Meters*, 1. *Hydrants*, Holly, 32. *Valves*, Holly.

Consumption, not given. *Pressure*: Ordinary, 45 lbs. Fire, 85 lbs.

Financial.—Cost, $20,000. Bonded debt, $4,000. Int., 4%. Ann. op. exp., $400. Ann. rev.: consumers, $1,800.

Management.—Water Board. Chairman, C. W. Giddins. Supt., Jno. T. Noble.

SAND BEACH, *Huron Co.* (Pop., 534; est., 1,500.) On Lake Huron at U. S. Harbor of Refuge, on level ground. Manufactures dairy salt, flour, lime and lumber. Settled in '50; incorp. a village in '82.

History.—Built in '81 by J. Jenks & Co., for fire protection.

Water Supply.—Lake Huron, by direct pumping.

Pumping Machinery.—Deane pump, dy. cap., 720,000 galls.

Distribution.—*Mains*, Wyckoff wood, 1 mile. *Hydrants*, Holly, 10.

Financial.—Cost, $4,000. No debt. Ann. op. exp., not given, but very small. No revenue.

Management.—Prest., Jeremiah Jenks. Secy. and Treas., B. Jenks.

SHERIDAN, *Montcalm Co.* (Pop., 661; est., 600.) Engaged in lumbering.

History.—Built in '82 by village, for fire protection.

Water Supply.—Pearl lake, by direct pumping.

Pumping Machinery.—Blake pump, dy. cap., not given.

Distribution.—*Mains*, Wyckoff wood, ½ mile. *Hydrants*, 4.

Pressure: 50 to 100 lbs.

Financial.—Cost, $3,500. No debt. Ann. op. exp., $183. No revenue.

Management.—Village Council. Village Clerk, J. P. Canlee.

STANTON, *Montcalm Co.* (Pop., 1,760; est., 1,800.

History.—Built in '85 by village. Des. Engr., M. Walker, Pt. Huron.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Walker pump, dy. cap., not given

Reservoir.—Is 45 by 122 ft., by 10 ft. deep.

Distribution.—*Mains*, wood, 2 miles. *Services*, not given. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $15,000. Debt, $8,000. Int., 6%. Ann. op. exp., $1,250. Ann. rev.: consumers, $900.

Management.—Address Max Jennings or Frank Miller.

TECUMSEH, *Lenawee Co.* (Pop., 2,111; est., 2,500.) Has manufactories.

History.—Built in '77 by village. Contr., E. Wilson, Tecumseh.

Water Supply.—Well, pumping to tank. The well is 40 ft. deep and "8 ft. wide."

Pumping Machinery.—Perkins windmill driving a force pump, dy. cap., about 20,000 galls.

Tanks.—Two, cap., about 80,000 galls. each.

Distribution.—*Mains*, Wyckoff wood, ¾ miles. *Services*, lead. *Taps*, 5. *Meters*, none. *Hydrants*, Ludlow, 15. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: 40 lbs.

Financial.—Cost, $7,000. No debt. Ann. op. exp., $150. Ann. rev.: consumers, $50.

Management.—Chf. Fire Dept., S. W. Bordine. Village Prest., Geo. Heesen.

THREE RIVERS, *St. Joseph Co.* (Pop., 2,525; est., 3,500.) On St. Joseph river at its confluence with Portage and Rocky rivers. Has water-power and various manufactories.

History.—Built in '82 by village.

Water Supply.—Nine 9-in. driven wells, 96 ft. deep, by direct pumping.

Pumping Machinery.—Walker pump, dy. cap., about 200,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, lead. *Taps*, 170. *Meters*, none. *Hydrants*, Holly, Chapman, 48. *Valves*, Holly, Chapman.

Consumption, 10,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 85 lbs.

Financial.—Cost, $35,000. Debt, $22,000. Int., 5%. Ann. op. exp., $500. Ann. rev.: consumers, $1,100; city, none.

Management.—Secy., H. D. Cushman. Pumping Engr., E. Bergert.

TRAVERSE CITY, *Grand Traverse Co.* (Pop., 1,897; est., 4,000.) At head of Grand Traverse Bay, Lake Michigan. Has foundries, saw, planing and flouring mills.

History.—Built in '81-2 by H. D. Campbell.

Water Supply.—Grand Traverse Bay, by direct pumping from two settling basins.

Intake Pipe.—Extends 500 ft. into the bay to 20 ft. of water.

Settling Basins.—Two, not described.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Walker pumps with 14-in. steam and 8½ in. water cylinders of 12-in. stroke.

Distribution.—*Mains*, Wyckoff wood, 6 miles. *Services*, galv. i. *Taps*, 208. *Meters*, 3. *Hydrants*, Flower, Galvin, 45. *Valves*, Flower, Galvin.

Consumption, 200,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $30,000. Debt, withheld. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,800; city, $3,000. Hydrant rental, average, $65.

Management.—Owner, H. D. Campbell. Supt., Donald F. Campbell.

VASSAR, *Tuscola Co.* (Pop., 670; est., 2,500.) On Cass river, 18 miles from Saginaw and 22 from Bay City. Manufactures lumber.

History.—Built in '88 by village, and will be put in operation Jan. 1, '89. Des. Engr., W. S. Parker. Const. Engrs. and Contrs., Michigan Pipe Co., Bay City. Subcontrs. for masonry, B. Burbridge, Bay City; for foundations, Burbridge & Watkins.

Water Supply.—From 6-in. artesian well and Cass river, pumping to standpipe and direct.

Pumping Machinery.—Holly-Gaskill, dy. cap., 1,500,000 galls.; boilers from Wickes Bros., E. Saginaw.

Stand-Pipe.—Is 15 ft. in diam. by 80 ft. high.

Distribution.—*Mains*, 4 to 10-in. Wyckoff wood, 5½ miles. *Hydrants*, Galvin, Mathews, 58. *Valves*, Galvin. *Pressure*: Ordinary, 75 lbs. Fire, 160 lbs.

Financial.—Cost, $29,000. Debt, $29,000. Int., 5%.

Management.—Village Prest., R. G. Lyon.

WEST BAY CITY, *Bay Co.* (Pop., 6,397; est., 12,500.) Near Bay City.

History.—Built in '80-3 by city. Engr., E. S. Van Liew. Contrs. for masonry and buildings. Donovan & Holland, West Bay City.

Water Supply.—Saginaw river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; Holly pumps, and 5 by 14-ft boilers.

Distribution.—*Mains*, c. i., Wyckoff wood, 9 miles. *Services*, wood, lead, w. i. Pipe furnished by Michigan Pipe Co., Bay City, and laid under the direction of the Water Board. *Taps*, 146. *Meters*, none. *Hydrants*, Galvin, Flower, Ludlow, Bailey, 83.

Consumption, 600,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 115 lbs.

Financial.—Cost, $78,500. Debt, $14,000. Int., 5%. Ann. op. exp., about $3,000, Ann. rev.; consumers, about $7,000; city about $8,000.

Management.—Supt., Secy. and Treas., E. S. Van Liew.

WHITE CLOUD, *Newaygo Co.* (Pop., 440; est., 1,000.) On White river. Manfactures lumber and shingles.

General Description.—Built in '86 by village, taking the supply from White river. Mode not given, but probably by direct pumping. There are two miles of Wyckoff wood pipes, 9 hydrants, and a pressure of 40 to 75 lbs. No further data can be obtained. Address C. E. Charbonear.

Water-Works Projected with Fair Prospects of Construction.

FRANKFORT, *Benzie Co.* (Pop., 782; est., 1,500.) On Lake Michigan, and has good harbor. Manufactures iron and lumber.

Proposed System.—The village has voted $10,000 of bonds for works. No plans have been made, and nothing will be done until the spring of '89, when two railways are expected to build through the village. Address Jacob May or Jno. B. Collins, Councilmen.

MARSHALL, *Calhoun Co.* (Pop., 3,795; est., 4,000.) On Kalamazoo river. Has water-power and manufactories.

Proposed System.—A franchise has been granted to Moffett, Hodgkins & Clarke, Watertown, N. Y., and the Marshall Water-Works Co. has been organized with a capital stock of $100,000. Real estate has been purchased, and it is proposed to begin work Feb. 1, '89, and to put the system in operation in Sept., '89. The supply will be taken from wells sunk in the rock, from springs, from Rice creek or Kalamazoo river, as the Common Council directs. Water will be pumped to a stand-pipe 20 ft. in diam. and 100 ft. high, with provision for direct pumping. There will be two independent double-acting compound pumps. The mains will be 12 to 4-in. cast-iron, and there will be 85 hydrants. Officers: Prest., J. L. Hotchkin; V. Prest., J. V. Clarke; Secy., H. N. P. Dole; Treas., J. F. Moffett. The offices are at Watertown, N. Y.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Albion, *Calhoun Co.*; Bellevue, *Eaton Co.*; Benton Harbor, *Berrien Co.*; Coldwater, *Branch Co.*; Corunna, *Shiawassee Co.*; Eaton Rapids, *Eaton Co.*; Fentonville, or Fenton, *Genesee Co.*; Harrisville, *Alcona Co.*; Howell, *Livingston Co.*; Iron Mountain, *Menominee Co.*; Owosso, *Shiawassee Co.*; Saint Ignace, *Mackinaw Co.*; Sturgis, *St. Joseph Co.*; Ypsilanti, *Washtenaw Co.*

ILLINOIS.

Water-Works Completed or in Process of Construction.

ALTON, *Madison Co.* (Pop., 8,975; est., 12,000.) On Mississippi river, four miles above the mouth of the Missouri river, and 25 from St. Louis, Mo. It is divided near the center by Pisa creek, from which, and the river, the ground rises rapidly, the highest elevation being 224½ ft. Engaged in river trade, and manufacturing. Town laid out in '17.

History.—Built in '75 by private company, name not given. Engr., Harry Taylor.

Water Supply.—Mississippi river, pumping to tanks and direct.

Intake Conduit.—To pump-well. Stone masonry in cement, 2 by 5 ft.

Filter.—Iron box, with a capacity of 54 cu. ft., perforated with holes and filled with sponge. The box is raised by a crane and the sponges washed when necessary.

Pumping Machinery.-Dy. cap., 3,500,000 galls; a 2,000,000-gall. horizontal duplex high-pressure Deane, and a 1,500,000-gall. Worthington pump.

Tanks.—Cap., 300,000 galls.; of wood, one 40 ft. in diam. and 24 ft. high, and one 32 ft. in diam., and 16 ft. high. They are placed about 30 ft. above the highest land in the city, and 260 ft. above the pumps.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. *Taps*, 230. *Meters*, not given. *Hydrants*, kind not given, 90.

Consumption, not given. *Pressure*: Ordinary, 85 lbs. Fire, 110 lbs.

Financial.—Cost, $110,000. Debt, $46,000. Int., 6%. Ann. op. exp., $9,413. Ann. rev.: withheld, but est., $12,000; city, $8,850.

Management.—Supt., T. A. Taylor.

NOTE:—The last returns from these works were in '86. In answer to our request for later data the Supt. replied:

"These works are owned by a private company; they don't care to have it [data concerning the works] go in your report."

AURORA, *Kane Co.* (Pop., 11,873; est., 20,000.) On Fox river, 28 miles from Chicago. Has various manufactories.

History.-Built in '85 by city. Engr., Chester B. Davis, Chicago, Ill., with J. C. Des Granges as Asst. Engr. Contrs. for masonry and buildings, L. T. Howard & Lewis Sylvester.

Water Supply.—Fox river, through galleries beneath river and island, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls; Deane pumps, and two 2 by 16-ft. tubular boilers.

Stand-Pipe.—Is 18 ft. in diam. and 153 ft. high; furnished by Water & Gas Construction Co., Pittsburg, Pa.

Distribution.—*Mains*, c. i., 22 miles. *Services*, lead. Pipe furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and specials by Union Foundry & Pullman Car Wheel Works Chicago. Trenching and pipe-laying done by B. E. Hattersley, Ft. Wayne, Ind. *Taps*, 750. *Meters*, 2. *Hydrants*, Ludlow, 250. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 743,499 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $168,000. Bonded debt, $138,000. Int., 5%. Ann. op. exp., $7,641. Ann. rev.: consumers, $10,000; city, none.

Management.—Board Public Works. Chairman, C. C. Earle. Clerk, J. M. Kennedy. Supt., J. W. Battle.

BARRY, *Pike Co.* (Pop., 1,392; est., 1,700.) Manufactures flour, woolen goods, and packs pork.

History.—Built in '80-1 by village. Labor done by the day.

Water Supply.—Artesian well 2,510 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., not given; furnished by Smith, Hill & Co., Quincy.

Tank.—Is 20 by 20 ft., at an elevation of 50 ft.

Distribution.—*Mains*, 6-in. c. i., about 1 mile. *Services*, iron. *Taps*, 20. *Meters*, none. *Hydrants*, Ludlow, 8.

Consumption, 6,000 galls. *Pressure*: 20 lbs.

Financial.—Cost, $13,000. Debt, $800. Int., 8%. Ann. op. exp., $200. Ann. rev.: consumers, $150; city, none.

Management.—Village Council. Mayor, B. McConnell.

BELLEVILLE, *St. Clair Co.* (Pop., 10,683; est., 17,000.) Is 14 miles from St. Louis, Mo. Manufactures nails, oil, stoves, pumps and glass.

History.—Built in '85 by City Water Co. Eng., S. H. Lockett. Contrs., Comegys & Lewis. Both of New York City.

Water Supply.—Richland creek, from impounding reservoir and filter basin, pumping to reservoir and stand-pipe.

Impounding Reservoir.—Cap., about 30,000,000 galls.; formed by damming the creek, and excavating about 12 acres to a depth of from 8 to 12 ft.

Filter Basin.—Formed by building a dam or embankment across a cove of the reservoir, and covering the reservoir side of the bank with 4½ ft. of gravel and sand, the other side being paved with brick. Drains lead through the bank.

Pumping Machinery.—Dy. cap., 2,500,000 galls; two compound duplex Worthington pumps, and two 70 H. P. Whittier boilers.

Distributing Reservoir.—Cap., 3,000,000 galls.; is 20 ft. deep. It is unofficially reported that a new reservoir was built in '88, near this one, with a cap. of about 15,000,000 galls.

Filter.—Hyatt, Dy. cap., 750,000 galls.

Stand-Pipe.—Cap., about 130,000 galls.; 15 ft. in diam., and 120 ft. high, and is on a hill 17 ft. above any other point in the city.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead. *Taps*, 240. *Meters*, 9. *Hydrants*, Ludlow, 101. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 130 lbs.

Financial.—Cost, $175,000. Capital stock, $250,000. Debt, withheld. Int., 6%. Ann. op. exp., $7,000. Ann. rev.: consumers, $8,000; city, $6,565. Hydrant rental, $65.

Management.—Prest., R. N. Hazard, New York City. V. Prest., E. J. Snow, Mattoon. Secy., J. M. Maguire, New York City. Supt. and Treas., M. J. Stookey.

BLOOMINGTON, *Mc Lean Co.* (Pop., 17,180. est., 28,000.) On an undulating prairie. Has extensive manufactories. Settled in '31; incorp. a city in '50.

History.—Built in '75 by city. Des. Engr., H. P. M. Birkinbine. Const. Engr., Ira Merchant. Some extensions or improvements have been made with Geo. C. Morgan, Chicago, as Engr.

Water Supply.—Surface and eight tube wells, pumping to stand-pipe and direct. The surface well is 40 ft. in diam. for 28½ ft., then has an 18-in. pipe sunk 10 ft. deeper. The ground at this point is 68 ft. below the highest point in the city.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; a 1,000,000-gall. Worthington pump erected in '75, and a 2,000,000-gall. Blake pump added in '81.

Stand-Pipe.—Cap., 75,000 galls.; 8 ft. in diam. and 20 ft. high, on ground 35 ft. above engine house floor. The foundation is octagonal, of stone, a heavy casting placed on this forming the base of the pipe. An octagonal brick tower encloses the pipe, being built 2 ft. from it. There is a winding stair case in the space between. The base of the wall is 6, and the top, 1 ft. thick. It has stood well.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., lead. *Taps*, 916. *Meters*, 175. *Hydrants*, Mathews, Flower, 194. *Valves*, Eddy.

Consumption, 900,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 150 lbs.

Financial.—Cost, $135,000. Bonded debt, $75,000. Int., 8%. Ann. op. exp., $9,000. Ann. rev.: consumers, $12,000; city, none. The op. exp. for '80 were $5,427, and the rev., $7,614.

Management.—Water Board of three. Supt., E. J. Rowley.

BLUE ISLAND, *Cook Co.* (Pop., 1,542; est., 3,000.) Is 16 miles from Chicago. Has brick yards, stone quarries and smelting works.

History.—Built in '76 by village.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Not described.

Tank.—Cap., 60,000 galls.; on stone tower, 50 ft. high.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 30. *Meters*, none. *Hydrants*, 34.

Financial.—Cost, $20,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: not given, but est., $1,200; city, none.

Management.—Address J. Link.

NOTE:—All requests for information have been ignored since '84.

BLUE MOUND, *Macon Co.* (Pop., of township, 1,204; est., of village, 800.)

History.—Built for fire protection in '86 by village. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago. Sub-contr. for masonry, Wm. Bacon, West Plains, Mo.

Water Supply.—Well, pumping to tank and direct.

Pumping Machinery.—Not given.

Tank.—Cap., about 25,000 galls.

Distribution.—*Mains*, Wyckoff wood, 2,000 ft. *Services*, iron. *Hydrants*, 8.

Financial.—Cost, $3,500. Bonded debt, $2,000. Int., 6%.

Management.—Report by G. W. Drysdale.

BUDA, *Bureau Co.* (Pop., 778; est., 1,000.)
History.—Built in '83 by Buda Water-Works Co.
Water Supply.—Source not given, pumping to tank.
Pumping Machinery.—Force pump, driven by windmill.
Tank.—Cap., about 30,000 galls.; 40 ft. high.
Distribution.—*Mains*, Wyckoff wood, 500 ft. *Taps*, 10. *Hydrants*, Holly, 4.
Financial.—Cost, $2,000. Capital stock, $2,000.
Management.—T. J. Lockwood.

CABERY, *Ford Co.* (Pop., est., 600.) Has brick and tile works.
History.—Built in '87 by village. Engr. and Contr., Jas. Porch, Chebanse, Ill.
Water Supply.—Artesian well, pumping to tank.
Pumping Machinery.—"Sandwich" pump, dy. cap., 15,000 galls.
Tank.—Cap., 45,000 galls.
Distribution.—*Mains*, 8 to 4-in. iron, 4,000 ft. *Services*, iron. *Taps*, 20. ***Meters***, none. *Hydrants*, Beaumont, 14. *Valves*, Beaumont.
Consumption, 1,000 galls. *Pressure*: not given.
Financial.—Cost, $6,500. Debt, $3,000. Int., 6%. Ann. op. exp., $50.
Management.—Village Officers: P. Wagoner, P. Whalen and Chas. Gebhart.

CAIRO, *Alexander Co.* (Pop., 9,011; est., 15,000.) At junction of Ohio and Mississippi rivers. Engaged in manufacturing and trade.

History.—Built in '85 and put in operation Jan. 1, '86, by Peter Herdic; known as the Cairo Water Co. Const. Engr., —— Ditmar, Williamsport, Pa. Labor done under direction of company.

Water Supply.—Ohio river, pumping to stand-pipe or direct. It is unofficially reported that a filtering crib was built in '88.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; duplex compound Gordon & Maxwell pumps. One a 16-in. high-pressure, the other a 23-in. low-pressure, each of 24-in. stroke.

Stand-Pipe.—Is 16 ft. in diam. and 150 ft. high; Contrs., Malttang & Son, Peoria.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 200. *Pressure-recording gauge*, Edson.

Consumption, about 250,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $130,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, but est., $10,000. Ann. rev.: consumers, withheld, but est., $20,000; city, $6,000, or $500 a month for all hydrants.

Management.—Address M. Portens. Report by E. Duryea, Jr.

CANTON, *Fulton Co.* (Pop., 3,762; est., 5,000.) Is 28 miles from Peoria. Manufactures ploughs, wheels and cigars, and mines coal.

History.—Built in '84 by town. Engr. and Contr., Geo. C. Morgan, Chicago, who received a commission of 10% on the cost of the works.

Water Supply.—Surface wells, pumping to stand-pipe and direct if required.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington compound duplex pump.

Stand-Pipe.—Is 12 ft. in diam. and 30 ft. high, on a brick tower 70 ft. high.

Distribution.—*Mains*, 8-in. c. i., 2 miles. *Services*, w.i. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, 100,000 galls. *Pressure*: Ordinary, 38 lbs. Fire, 200 lbs.

Financial.—Cost, $23,000. Debt, $32,000. Int., 6%. Ann. op. exp., $1,000. Ann rev.: consumers, $800; city, $200.

Management.—City Clerk, I. T. Atwater.

CARLYLE, *Clinton Co.* (Pop., 2,017; est., 2,500.) On Kaskaskia river.

History.—Built in '86-7 by Carlyle Water, Light & Power Co., under a 21 years' franchise. Engr., F. W. Raeder, St. Louis, Mo. Labor on masonry and buildings done by the company.

Water Supply.—Source not given, pumping to stand-pipe.

Pumping Machinery.—Deane pump, dy. cap., not given.

Stand-Pipe.—Steel, 10 ft. in diam. and 110 ft. high. Contrs., Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 35. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 20,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost. withheld. Capital stock, $50,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $300; city, $2,100.

Management.—Prest., J. J. Randall. Secy., F. W. Raeder, St. Louis, Mo.

CARTHAGE, *Hancock Co.* (Pop., 1,594; est., 2,500.)

History.—Built in '87 by town, under direction of a committee. Const. Engr. and Contrs., U. S. Wind Engine & Pump Co., who partly own the works.

Water Supply.—Artesian well, 1,800 ft. deep, pumping from receiving reservoir to tank and direct.

Reservoir.—Cap., 60,000 galls.

Pumping Machinery.—Dy. cap., 500,000 galls.; Knowles duplex pump.

Tank.—Cap., 61,770 galls.; 20 by 24 ft., on an elevation of 60 ft. above the ground.

Distribution.—*Mains*, 6, 5 and 4-in. Wyckoff wood, 1 mile. *Services*, not given. *Taps*, 25.

Pressure: Ordinary, 40 lbs. Fire, 160 lbs.

Financial.—Cost, $14,000. Debt, $10,000. Int., 6%.

Management.—Com.; T. J. Schofield, Jno. Elder and E. M. Robbins.

CHAMPAIGN and URBANA, *Champaign Co.* (Pop.: Champaign, 5,103; est., 6,500. Urbana, 2,942; est., 3,000.) The towns are adjacent, on level ground, 720 ft. above the sea.

History.—Built by Union Water Supply Co., in '85, under a 30 years' franchise from Champaign and a 15 years' franchise from Urbana. Des. Engr., T. J. Whitman. Const. Engr., C. H. Ledlie.

Water Supply.—Surface well, by direct pumping and pumping to reservoir. The well is an abandoned prospecting coal shaft, 8 by 12 ft., by 80 ft. deep. Before pumping water was 40 ft. below the surface.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two vertical compound Gordon & Maxwell pumps, and Robinson & Burr boilers.

Filter.—Plant put in by National Water Purifying Co., New York City.

Reservoir.—Cap., 250,000 galls.; 60 ft. sq. by 16 ft. deep. In excavation and embankment, lined with brick in cement.

Distribution.—*Mains*, c. i., 13 miles: 7 in Champaign and 6 in Urbana. *Services*, *Taps* and *Meters*, withheld. *Hydrants*, Ludlow, 90: 51 in Champaign and n Urbana. *Valves*, Ludlow.

Consumption, 250,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost, $200,000. Capital stock, $100,000. Bonded debt, $100 00. Int., 6%. Ann. op. exp., $10,000. Ann. rev.: consumers, $6,680; cities, $5,326. Hydrant rental, $75 in Champaign and $40 in Urbana.

Management.—Prest., L. H. Trerett. Treas., Wayne Lundit. Supt. and Secy., S. L. Nelson.

CHARLESTOWN, *Coles Co.* (Pop., 2,867; est., 4,000.) On undulating prairie, 3 miles west of Embarras river. Manufactures flour, brooms and woolen goods. Settled in '33; incorp. a city in '73.

History.—Built in '76 by city.

Water Supply.—Embarras river, by direct pumping. The river is 134 ft. below the city, and 3 miles distant.

Pumping Machinery.—Dean duplex pumps, dy. cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, (in '86,) 600. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Bonded debt, $21,000. Int., 10%. Ann. op. exp., $3,300. Ann. rev.: consumers, $3,500; city, none.

Management.—Secy. Water Board, C. E. Winter. Supt., H. Gramsley.

CHEBANSE *Iroquois Co.* (Pop., 728; est., 900.)

History.—Built in '76 by Chebanse Water-Works Co., under the direction of Jas. Porch and R. Nation.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Force pump, driven by windmill.

Tank.—Cap., about 30,000 galls.

Distribution.—*Mains*, 4 and 6-in. c. i., 1,500 ft. *Services*, not given. *Taps*, 20. *Meters*, none. *Hydrants*, Beaumont, 16.

Consumption and *Pressure*, not given.

Financial.—Cost, $3,500. Capital stock, $3,500. No debt. Ann. op. exp. $50. Ann. rev.: consumers, withheld, but est., $500; city, none.

Management.—Geo. Burrill. Report by Jas. Porch.

CHICAGO, *Cook Co.* (Pop., 503,185; est., pop. in water district, 775,000.) On Lake Michigan, 591 ft. above the sea, on a plain which was originally low and swampy, with an average elevation of 12 ft. above the lake. The city lies on both sides of the Chicago river, for 5 miles from the mouth of which, in any direction, the city is not more than 23 ft. above the lake. The city covers an area of nearly 37 sq. m., and there are 638½ miles of streets.

History.—Supplied in '40 by the Chicago Hydraulic Co., a private corporation, and since '54 by works built by the city in '52-4.

The first works consisted of an 18-in. intake extending from a crib in Lake Michigan 700 ft. to a pump-well, 15 ft. deep, from which a steam pump forced water through several miles of 2, 3 and 6-in wooden pipe. The population in '40 was 4,500.

In '51 the Legislature incorporated the Chicago City Hydraulic Co., composed of three commissioners elected by the people. When these works were finished, in '54, the population was about 75,000. Wm. J. McAlpine was Des. Engr.

In '61 the works came under the control of a Board of Public Works, with E. S. Chesbrough as City Engr. Mar. 17, '64, the construction of the first lake tunnel was begun, and it was finished Mar. 25, '67. The second lake tunnel was built in '72-4, and a third is now in progress.

In the great fire of '71 the pumping station was burned, the engines being damaged so that one was not put in use again for 8 days, and the others for nearly a month. The first week after the fire a partial supply was obtained by pumping from wells to the mains.

THE WORKS PRIOR TO MAY 6, '61.

Water was drawn from Lake Michigan to a pump-well 20 by 30 ft., by 25 ft. deep, inclosed by a stone wall 6 to 7 ft. thick. A vertical beam engine, with 44-in. cylinder and 108-in. stroke, drove two single-acting pumps of 34-in. bore and 66-in. stroke, lifting water to a stand-pipe, 136 ft. high. This was enclosed in a brick tower 14 ft. at the base and 11 at the top, built in two divisions, one being used as a smoke stack. The foundation was on sand 6 ft. below the surface. Owing to irregular settlement during construction the tower was at one time 14 ft. out of plumb. It was straightened.

An auxiliary non-condensing engine with 18-in. cylinder of 72-in. stroke, driving a double-acting pump of the same dimensions, was in use for two years.

For four months after the works were put in operation water was not furnished Sundays, and for only nine hours on other days.

A 12-in. pipe laid across the river at State St. was broken by a vessel's anchor, and replaced by a 30-in. pipe.

In '56 a 24-in. submerged wrought-iron pipe was laid in a dredged trench, in 18 ft. of water, and covered with 3 ft. of sand. Before being put in use a pile was accidentally driven through one section of it. In '59 a 10, and in '60 a 24-in. pipe was laid across the river.

In '56 52¼ miles of cast-iron pipe had been laid. In that year a new engine with a a 60-in. cylinder of 120-in. stroke, and two 40-in. double-acting pumps of 72-in. stroke was built.

A wrought-iron tank on masonry walls had been built in '54, and in '56 two more were built, on three concentric circular walls, 3 ft. thick, 7 ft. apart, and 42½ ft. high. The outer wall was 62 ft. in diam., of stone masonry, and the inner walls brick. On these were placed 9-in. wrought-iron beams, radiating from the center and 2 ft. apart at the ends. On the beams rested a 5-16 in. wrought-iron tank 60 ft. in. diam. and 28 ft. high, braced on the outside and tied by iron rods connected at the center. Around the tank was a 12-in. air space, the outer casing and the roof being of wood.

The water surface was 84 ft. above the lake, and the supply and distributing pipes entered at the bottom.

Previous to '60 the turbidity of the water gave much annoyance, and about this time E. S. Chesbrough was directed to make the examination which resulted in his recommendation to build the first tunnel.

THE PRESENT WORKS.

Water Supply.—Lake Michigan, by direct pumping, water being taken from the lake through tunnels, of which there were about 9 miles in '87.

First Tunnel.—Extends from a shaft near the lake shore to crib inclosing a shaft two miles out in the lake. It was 5 ft. wide and 5 ft. 2 in. high, lined with brick, and was driven through clay, about 30 ft. below the lake bottom. It cost $457,845.

First Pump-Well.—Receives water from tunnel at North Side station. Is 21 ft. deep, in quicksand. A brick masonry curb was built, 31½ ft. inside diam., and 2¾ ft. thick at the bottom, resting on an iron shoe 2½ ft. deep, with a cutting edge. The excavation was made with a dredging machine.

The bottom of the well was covered with two courses of 3-in oak plank, on which 10-in. pine timbers were placed, filled between with concrete, and covered with another course of 3-in. oak plank, then 9 in. of concrete. On this were built the foundations of the first two pumping engines. Other pump-wells have been sunk since this.

Second Tunnel.—Is 7 ft. in diam., parallel to and 46 ft. from the first. A shaft was sunk in the lake near the crib of the first tunnel, and a cross tunnel run between the two. At the shore end this tunnel is connected with the North Side station, then continued through the city four miles, passing under the Chicago river and South Branch, to the West Side station, delivering into a pump-well 10 by 44 ft., with walls of squared stone founded on rock 44½ ft. below the surface.

The Third Tunnel.—This will be about four miles long, and will connect with the second.

Pumping Machinery.—Cap., 150,000,000. Contracts for additional pumps with a cap. of 75,000,000 galls. were let in '88 to E. P. Allis & Co., Milwaukee, Wis. At the North Side station there are four double and two single pumps, two of these being Holly-Gaskill pumps, with a dy. cap. of 24,000,000 galls., erected in '87.

At the West Side station there are four pumps. Aside from the Holly pumps, the others were built by the Morgan Iron Works and the Quintard Iron Works, New York City; the Knapp Foundry, and the Pitt Foundry, Co., Pittsburg, Pa.

At the West Side station in '80 the total pumpage was 20,045,528,600 galls., against a head of 97.3 ft. The cost of repairs per 1,000,000 galls. was 18.19 cents. The total cost of pumping 1,000,000 galls. was $4.49, or raised 1 ft., 4.61 cents.

Details of the pumpage and cost of same at the North side station could not be given for '88, owing to the condition of the pumps, their work having been greatly overrated previous to a detailed examination by Asst. Engr., Thos. T. Johnston. He found one of the pumping engines in very bad condition, a set of cards taken in July, '87, indicating 210 H. P. when the engine should have indicated 350 H. P. It appeared that for some time this pumping engine had not been doing more than one-third of full capacity, while it had been supposed to be working well.

Stand-Pipes.—One at the North Side station 3 ft. in diam. and 138 ft. high, enclosed in an octagonal stone tower 154 ft. high. About '76 one was built at the West Side station, 5 ft. in diam, and 167 ft. high. It was enclosed in an ornamental masonry tower 190 ft. high.

River Crossings.—The frequent accidents to submerged mains led to the construction of brick tunnels, 6 ft. in diam., in which the pipes are laid.

Distribution.—*Mains*, c. i., 638.23 miles. *Services*, lead. *Taps*, about 100,000. *Meters*, 3,273; first used in '60. *Hydrants*, kind not given, 5,899. *Pressure-recording gauge*, Edson.

Consumption, (for '86,) 91,647,632. [Cannot be given for '87 owing to the trouble at the North Side Station.] *Pressure*: 25 lbs.

Financial.—Cost, $11,393,422. Bonded debt, $3,955,000: $3,490,000 at 7, $132,000 at 6, and $333,000 at 3.65%. Ann. op. exp., about $1,016,000. Ann. rev.: consumers, $1,529,102.

The cost of the works to May 6,'61, when they were transferred from the charge of the Board of Water Commissioners to the Board of Public Works, was $1,020,160. To Jan. 1, '80, the cost of the works had been $8,644,754, and the receipts, $10,334,655. The revenue for '80 was $865,618, or $41.21 per million galls. furnished. In '85 the revenue per million gallons was $40.03, and in '86, $38.52.

The highest revenue per million gallons recorded was in '58, $93.57, since when there has been a decrease, except in special years, it rising to $95.30 in '66.

Management.—Comr. of Public Works, Geo. B. Swift. Registrar, W. H. Maher.

Engr. at North Pumping Works, Henry Welsh; at West, H. Mason. Supt. Water Meters, H. A. Hawkins. Chf. Engr. of Water-Works, F. W. Gerecke.

CLINTON, *De Witt Co.* (Pop., 2,709; est., 3,000.) Has railway machine shops.

History.—Built in '87-8 by village. Engr., Jno. W. Nier, Kansas City, Mo.

Water Supply.—Well, pumping to stand-pipe. Contr. for well, R. H. Ross, Clinton.

Pumping Machinery.—Deane pump, dy. cap., not given.

Stand Pipe.—Is 120 ft. high.

Distribution.—Pipe and specials supplied by Ripley & Bronson, St. Louis, Mo. *Hydrants* and *Valves*, Bourbon.

Managemet.—Supt., P. W. Henry.

Note:—No further data can be obtained.

DANVILLE, *Vermillion Co.* (Pop., 7,733; est., 1,200.) On Vermillion river, in bituminous coal region. Settled about '10; since incorp. a city.

History.—Built in '82-3 by Danville Water Co., under a 30 years' franchise. Des. Engrs., K. P. Corbyn and Frank Shefold. Const. Engr., J. M. Carson, the present Supt. Contr. for masonry, P. M. Norton; for buildings, J. M. Hunkey. Both of Danville.

Water Supply.—North Fork of Vermillion river, and Clear lake reservoir, pumping to stand-pipe.

Intake Pipe.—Is 20 in. in diam. and passes from the stream through a revetment wall and delivers water to a settling well, with provision for a direct connection with the pump-well.

Settling Well.—Is 40½ ft. in diam. and 27 ft. deep, having a cap. of 180,000 galls. A 20-in. pipe extends to the pump-well, which is 18 ft. in diam.

Clear Lake Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two Blake pumps, and four 5 by 18-ft. boilers.

Stand-Pipe.—Of ½-in. iron, 3½ ft. in diam. and 200 ft. high; founded on masonry 12 ft. sq. and 12 ft. thick, with a brick casing for 100 ft., above which it is double rivetted. Contrs., Rohan Bros., St. Louis, Mo.

Distribution.—*Mains*, c. i., 14.3 miles. *Services*, galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe laying done by L. M. Brown & Co., Danville. *Taps*, 505. *Meters*, 25. *Hydrants*, Ludlow, 107. *Valves*, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 407,045 galls. *Pressure*: Ordinary, 70 lbs. Fire, 85 lbs.

Financial.—Cost, $173,000. Capital stock, $200,000. Bonded debt, $150,000. Int., 7%. Ann. op. exp., $8,782, including all taxes. Ann. rev.: consumers, $10,500; city, $7,937. Hydrant rental, $75 for first 100, $62.50 for next 45, and $50 for additional.

Management.—Prest., S. A. Miller. V. Prest., Geo. J. Long. Secy., Wm. Reinecke. Supt., J. M. Carson.

DECATUR, *Macon Co.* (Pop., 9,547; est., 16,000.) On right bank of Sangamon river on flat bottom land, the soil being underlaid with gravel.

History.—Built in '71 by town. Const. Engrs., Kinsey & Mahler.

Water Supply.—Sangamon river, by direct pumping.

Filter Crib.—Is 600 ft. long, 10. ft. wide, 6 ft. high, arched over. Water is conveyed from this to the pump-well. At first a 22-in. pipe connected the pump-well and the river, and an independent connection is still maintained for use in dry weather.

Pumping Machinery.—Allis pump, dy. cap., 2,000,000 galls. Two Cameron pumps and a Holly rotary were first used.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. *Taps*, 660. *Meters*, 11. *Hydrants*, Holly, Mathews, Galvin, 124.

Consumption, 1,150,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, $160,000. Debt, $35,000. Int., not given. Ann. op. exp., about $10,000. Ann. rev.: consumers, $16,000; city, none.

Management.—City Clerk, F. C. Betzer. Chf. Pumping Engr., Jno. T. Barnett.

DE KALB, *De Kalb Co.* (Pop., 1,598; est., 3,000.) On Kishwaukee creek on level ground. Manufactures barbed fence wire. Settled in '36; incorp. a village in '51.

History.—Built in '74 by village. Engr. and Contr., Geo. C. Morgan, Chicago,

Water Supply.—Artesian well, 6 in. in diam. and 2,500 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 100,000 galls.; Deane duplex pumps. A windmill was formerly used for power.

Tank.—Cap., 60.000 galls.; 25 ft. in diam. at bottom and 16 ft. high, 48 ft. above the pump, and 65 ft. above the main street.

Distribution.—*Mains*, c. i., 3 miles. *Services*, lead. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 35.

Consumption, 60,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 110 lbs.

Financial.—Cost, $3,000. No debt. Ann. op. exp., $355. Ann. rev.: consumers, $1,600; city, none.

Management.—Supt., L. R. Waldron.

DIXON, *Lee Co.* (Pop., 3,658; est., 5,000.) On Rock river, which furnishes water-power.

History.—Built in '84 by A. H. McNeal and S. S. Murphy, Burlington, N. J., and sold to Dixon Water Co., Mr. Murphy holding nearly all the stock.

Water Supply.—Rock river and springs, pumping to reservoir and direct.

Pumping Machinery and Reservoir.—Not described.

Distribution.—*Hydrants*, 65. *Pressure*: Ordinary, 45 lbs. Fire, 100 to 150 lbs.

Financial.—Cost, $80,000. Capital stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., about $2,000. Ann. rev.: consumers, withheld, but est., $10,000; city, $4,875. Hydrant rental, $75.

Management.—Prest., Jno. D. Crabtree.

NOTE:—No report for '88 can be obtained from the company. Most of the above data was given by Jas. A. Hawley.

EAST SAINT LOUIS, *St. Clair Co.* (Pop., 9,185; est., 22,000.) On Mississippi river, opposite St. Louis, Mo.

History.—Built in '86 by City Water Co., which is controlled by the American Water Works & Guarantee Co., Ltd., Pittsburgh, Pa. The franchise is for 20 years. Des. Engr., W. S. Kuhn, Pittsburgh, Pa. Const. Engr., J. H. Purdy. Contrs. for masonry and buildings, Nevins & Reimer.

Water Supply.—Mississippi river, pumping to reservoir and stand-pipe.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; Worthington and Blake pumps.

Reservoir.—Not described.

Stand-Pipe.—Is 15 by 100 ft. Contr., T. Wagner.

Distribution.—*Mains*, c. i., 15¾ miles. *Services*, galv. i. Pipe and specials furnished by Shickle, Harrison & Howard, St. Louis, Mo. *Taps* and *Meters*, withheld. *Hydrants*, Chapman, 161. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, est., 3,500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $275,000. Capital stock, $250,000. Bonded debt, $250,000. Int., 6%. Ann. op. exp. and rev., withheld. Hydrant rental, $100.

Management.—Prest., W. S. Kuhn, Pittsburgh, Pa. Secy., S. M. Highlands. Treas., J. H. Purdy. Supt., F. M. Horner.

ELGIN, *Kane Co.* (Pop., 8,787; est., 17,000.) On Fox river, which furnishes water-power.

History.—Built in '87-8 by city; put in operation July, '88. Consulting Engr., Chester B. Davis, Chicago. Const. Engrs., Hugh Anderson, W. C. Hawley and T. F. Witmar. Contr. for masonry, Jno. Joslyn.

Water Supply.—Fox river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two low-pressure duplex Worthington pumps, and boilers from Oil City (Pa.) Boiler Works.

Filter.—Dy. cap., 2,500,000 galls.; from American Filtering Co., Chicago.

Stand-Pipe.—Cap., 510,000 galls.; 30 ft. in diam. and 115 ft. high; Contrs., Shickle Harrison & Howard, St. Louis, Mo.

Distribution.—*Mains*, 6 to 24-in. c. i., 13 miles. *Services*, lead. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and trenching and pipe-laying done by Carothers & Hutzed. *Taps*, 327. *Meters*, Thompson, Hersey, number not given. *Hydrants*, Ludlow, 158. *Valves*, Eddy.

Consumption, 328,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 90 to 150 lbs.

Financial.—Cost, $150,000. Bonded debt, $118,000. Int., 5%. Other data not determined.

Management.—Water Commrs.

EL PASO, *Woodford Co.* (Pop., 1,390; est., 2,500.) Is 17 miles from Bloomington. Settled in '50; incorp. a city in '66.

History.—Built in '82 by city after plans by Dr. Frederic Cole.

Water Supply.—Well, pumping to tank and direct. The well is 10 ft. in diam. for 60 ft., then has three 3-in. holes bored 54 ft. deeper.

Pumping Machinery.—Dy. cap., about 90,000 galls.; Smith & Vaile duplex pump, [probably] driven by an Eclipse windmill, and lifts water 58 ft.

Tank.—Of wood, 16 ft. in diam. and 24 ft. high, on a timber trestle.

Distribution.—*Mains*, Wyckoff wood, 2½ miles. *Services*, iron. *Taps*, 35. *Meters*, none. *Hydrants*, Holly, 20.

Consumption, about 6,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $12,000. No debt. Ann. op. exp., $50. Ann. rev.: consumers not given, but est., $800; city, none.

Management.—Supt., E. S. Paul.

EUREKA, *Woodford Co.* (Pop., 1,183; est., 1,500.)

History.—Built in '86 by village. Des. Engrs., Fairbanks, Morse & Co., Chicago. Const. Engr., Geo. W. Anthony, Eureka. No general contracts let.

Water Supply.—Well, pumping to tank or direct. The well is 12 ft. in diam. and 60 ft. deep, and has 20 ft. of water.

Pumping Machinery.—Worthington pump, dy. cap., 260,000 galls.

Tank.—On brick tower, 60 ft. to bottom of tank; tank is 16 ft. in diam. and 24 ft. high.

Distribution.—*Mains*, w. i., 4,500 ft. *Services*, not given. *Taps*, 45. *Meters*, none. *Hydrants*, kind not given, 9.

Consumption, 15,000 galls. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, $6,500. Bonded debt, $5,000, running 20 years. Int., 6%. Ann. op. exp., and rev., withheld.

Management.—Chairman Com., F. M. Hoyt.

EVANSTON, *Cook Co.* (Pop., 4,400; est., 10,000.) On Lake Michigan, 12 miles north of Chicago.

History.—Built in '74 by town. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Lake Michigan, by direct pumping.

Intake.—A perforated plate iron box, filled with gravel, is located 1,000 ft. from the shore in 21 ft. of water, and connected with the pump-well by a 16-in. pipe with flexible joints.

The first intake was a gravel-filled crib extending 125 ft into the lake, intended to act as a filter. In '76 a bar formed outside the crib, and it was impossible to pump more than an hour at a time.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; Holly and Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps*, (in '81), 400. *Meters*, none. *Hydrants*, Cregier, 100. *Valves*, Ludlow.

Consumption, 1,200,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $118,900. Bonded debt, $32,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: total, $12,000.

Management.—Address Saml. Peeney or J. J. Adams.

FAIRBURY, *Livingston Co.* (Pop., 2,140; est., 2,700.) Has manufactories.

General Description.—Built in '87 by village. Water is pumped to a tank at an elevation of 75 ft., having a cap. of 60,000 galls. There are 8-in. mains, 12 hydrants and the pressure ranges from 75 to 175 lbs. Address L. B. Demming or Amos Brown.

FREEPORT, *Stephenson Co.* (Pop., 8,516; est., 12,000.) On Pekatonica river, on a bluff 70 to 100 ft. above the river. Has manufactories. Settled in '35.

History.—Built in '82 by Freeport Water Co. Engr., J. D. Cook, Toledo, O. Contr., Nathan Shelton, Omaha, Neb.

Water Supply.—Artesian wells and Pekatonica river, the latter being filtered, pumping to stand-pipe and direct. There are 17 3 in. and one 2-in. wells, averaging about 42 ft. in depth and driven 20 ft. apart. Each well is connected to a 16-in. cast-iron suction pipe. The wells were driven under the direction of Supt. Josel.

The river supply is from a well in gravel, near the bank, 25 ft. in diam. and 28 ft. deep.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; Knowles pumps.

Stand-Pipe.—Of plate iron, 15 ft. in diam. and 88 ft. high, on ground 107 ft. above the river, and 175 ft. above the center of the city.

Distribution.—*Mains*, 16 to 4-in. c. i., 12½ miles. *Services*, not given. *Taps*, 450. *Meters*, 25. *Hydrants*, Mathews, 96. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $173,600. Capital stock, $150,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., withheld, but est., $10,000. Ann. rev.: consumers, withheld, but est., 20,000; city, $9,600.

Management.—Prest., Nathan Shelton, Omaha, Neb. Secy., A. Barshinger. Treas., O. Bidwell. Supt., F. E. Josel.

FULTON, *Whiteside Co.* (Pop., 1,733; est., 2,500.) On Mississippi river.

History.—Built in '87-8 by village. Des. Engr., E. P. Wheeler. Const. Engr., V. B. Briggs. Contrs., Eclipse Wind Engine Co., Beloit, Wis.

Water Supply.—Well, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 240,000 galls.; Deane pump, and Erie boiler.

Reservoir.—Cap., 100,000 galls.; 15 by 80 ft., by 12½ ft. deep.

Distribution.—*Mains*, Kalamein i., 6,000 ft. *Hydrants*, 13.

Financial.—Cost, $14,000. Debt, $10,000. Int., 5%.

Management.—City Clerk, A. W. Bastian.

GALENA, *Jo Daviess Co.* (Pop., 6,451; est., 9,000.) On Galena river, four miles from the Mississippi. Manufactures furniture, carriages, lumber, farm implements and has marble and stone works and iron foundries.

History.—Built in '86-7 by Galena Water Co. Engr., E. S. Alexander, Chicago.

Water Supply.—Artesian well, 8 in. in diam. by 1,520 ft. deep, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; two compound duplex pumps furnished by National Iron & Brass Works, Dubuque, Ia., and two 4½ by 14-ft. steel boilers.

Stand-Pipe.—Is 20 ft. in diam. and 55 ft. high: Contrs., Iowa Iron Works, Dubuque.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, Kalamein i. Pipe and specials furnished by Shickle, Harrison & Howard, St. Louis, Mo., and trenching and pipe-laying done by A. W. Stevens, Logansport, Ind. *Taps*, not given. *Meters*, none. *Hydrants*, Ludlow, 72. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 90 to 100 lbs. Fire, 100 to 125 lbs.

Financial.—Cost, $75,000. Bonded debt, $35,000. Int., 6%. Ann. op. exp., withheld, but est., $6,000. Ann. rev.: consumers, withheld, but est., $10,000; city, $3,000.

Management.—Prest., Chas. A. Lamb. Secy., H. S. Raymond. Supt., W. A. Bixby.

GALESBURG, *Knox Co.* (Pop., 11,437; est., 15,000.) On level ground. Engaged in manufacturing and trade.

GALESBURG WATER CO.'S WORKS.

History.—Built in '83. Engr., F. E. Josel. Previous to this the city had laid 1¼ miles of mains which were sold conditionally to the company. The franchise was granted to Nathan Shelton, who formed a company with the above name.

The supply proved to be of a bad quality a few months after the works were put in and upon examination it was found that it had been taken from a creek which received drainage from slaughter houses and other sources. The city annulled its contract, and the case went to the Supreme Court, when Judge Gresham sustained the city's action on ground of non-compliance, and the title to the old mains was vested in the city.

Since the discovery of the pollution of the supply the company has sunk artesian wells.

No report has been given since '84, when the following was submitted.

Water Supply.—Well, 15 ft. in diam. and 70 ft. deep, pumping to stand-pipe, with an artesian well supplying a reservoir for reserve.

Pumping Machinery.—Dy. cap., not given.; two Worthington pumps.

Stand-Pipe.—Of plate iron, 15 ft. in diam. and 132 ft. high.

Distribution.—*Mains*, 16 to 6-in. c. i., 8 miles. *Services*, w. i. *Taps*, 175. *Hydrants*, 82.

Financial.—Capital stock, $150,000. Hydrant rental, $100.

Management.—Prest., Nathan Shelton. Secy. and Treas., T. R. Sylvanus. Supt., W. M. Flanagan.

PRESENT CITY WORKS.

General Description.—Since the companys' contract was annulled and the ownership of the 1½ miles of old mains vested in the city, a good supply of water has been obtained by the city, ½ mile of mains laid, a pumping station is now operated, and some consumers supplied. For fire pressure an arrangement has been made with the C. B. & Q. R. R. June, '88, city proposed to put in a complete system. Chas. Waste was Chairman Fire and Water Co.

GENESEO, *Henry Co.* (Pop., 3,518; est., 5,000.) On level ground, 23 miles from Rock Island. Settled in '37; incorp. a town in '55, a city in '65.

History.—Built in '79-82 by city. Con'r. for masonry and foundations. P. B. Perkins.

Water Supply.—Artesian wells, by direct pumping from reservoir. The first well was 6 in. in diam. and 800 ft. deep, the principal yield being from a stratum 120 ft. below the surface. The second well was sunk in '87, and yields about 275,000 galls. a day.

Reservoir.—Is 22 by 40 ft., by 10 ft. deep, and receives water from the second well.

Pumping Machinery.—Dy. cap., 250,000 galls.; two Walker pumps, and two horizontal tubular boilers. A Dayton pump was used to lift water from the first well.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. Pipe and specials furnished by Columbus (O.) Pipe Co., and R. D. Wood & Co., Philadelphia, Pa. Trenching done by J. Carroll and pipe-laying by A. White & Co. *Taps*, 60. *Meters*, none. *Hydrants*, Chapman, Perkins, Mathews, 38.

Consumption, 25,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 90 lbs.

Financial.—Cost, $21,000. Debt, $5,000. Int., 7%. Ann. op. exp., $1,400.; Ann. rev.: consumers, $500; city, none.

Management.—City Council. Supt., L. C. Campbell. Report by A. White.

GREENVILLE, *Bond Co.* (Pop., 1,886; est., 2,000.)

History.—Built in '84 by town. Des. Engr., J. G. Briggs. The masonry and foundations were put in by the village.

Water Supply.—Well, 22 ft. in diam. by 45 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 144,000 galls.; two double-acting Blake pumps.

Distribution.—*Mains*, 6 to 8 in. Kalamein i., 2 miles. *Services*, w. i. Pipe and specials furnished and laid by E. H. Gray, Chicago. *Taps*, 100. *Meters*, none. *Hydrants*, Bailey, 22. *Valves*, Eddy. *Gate boxes*, Brigham & Morgan.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 175 lbs.

Financial.—Cost, $24,000. Bonded debt, $16,000. Int., 6%. Ann. op. exp., $1,300. Ann. rev.: consumers, $1,200, including $800 from a railway company.

Management.—Report by Chas. Breuchard.

HILLSBORO, *Montgomery Co.* (Pop., 1,808; est., 2,000.)

History.—Built in '88 by village. Des. Engr., W. R. Coats, Kalamazoo, Mich. Const. Engr., Wm. E. Hinsdale, of the Eclipse Wind Engine Co., Beloit, Wis., who were the Contrs. The original plans were changed to lessen the cost.

Water Supply.—Well 20 ft. in diam. and 21 ft. deep, pumping to tank; direct pumping is used in case of fire.

Pumping Machinery.—Worthington pump, dy. cap., 500,000 galls.; 4½ by 16-ft. steel boiler furnished by Pond Engineering Co., St. Louis, Mo.

Tank.—Cap., 50,000 galls.; of cypress on 70-ft. trestle.

Distribution.—*Mains*, 8 to 4-in. c. i., 1¾ miles; furnished by Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Hydrants*, Mathews, 21. *Valves*, Galvin. *Valve boxes*, from A. W. Morgan & Co., Buffalo, N. Y.

Pressure: 200 lbs. specified.

Financial.—Cost, $15,000.

Management.—City Clerk, Geo. C. Pryce.

HOOPESTON, *Vermillion Co.* (Pop., 1,272; est., 2,800.) Manufactures tile, flax-tow, and has canning factories.

History.—Built in '88 by village. Engr. and Contr., George C. Morgan, Chicago.

Water Supply.—Deep well and reservoir, pumping to tank.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Deane pumps.

Tank.—Cap., 30,000 galls.; Morgan's special water tower.

Distribution.—*Mains*, 8 to 4-in. c. i., 2½ miles. *Hydrants*, Morgan. *Valves*, Crane.

Financial.—Cost, $20,000.

Management.——Chairman Com., A. T. Catherwood; Mayor, A. H. Trego.

HOPEDALE, *Tazewell Co.* (Pop. of township, 1,354; of village, est. 900.)

General Description.—Built in '88-9 by village. Contr., C. M. Houghton, Delaware. Pumping machinery furnished by Robt. London, Bloomington. Water pumped to 50,000-gall. tank. Cost, $4,000. Debt, $2,500. Int., 7%. Village Clerk, Ben S. Ford.

HYDE PARK, *Cook Co.* (Pop., 15,716; est., 100,000.) In township of Lake, on Lake Michigan, 7 miles south of Chicago. Incorp. a village in '72.

History.—First supplied in '76 from works built by Hyde Park and Lake, jointly. In '82 Hyde Park erected independent works as described below.

Water Supply.—Lake Michigan, through tunnel, by direct pumping.

Temporary Intake.—A 16-in. cast-iron pipe laid on the lake bottom for 1,620 ft., and a tunnel from this to the engine-house, 1,000 ft. long, and 5 ft. 2 in. in diam.

Lake Tunnel.—Is 6 ft. in diam. and 1½ miles long.

Pumping Machinery.—Dy. cap., 18,000,000 galls., with 12,000,000 galls. additional contracted for. The present pumps are 12,000,000-gall. Holly-Gaskill, and 6,000,000-Cope & Maxwell. The new pump is a 12,000,000-gall. Worthington.

Distribution.—*Mains*, c. i., 95 miles. *Services*, lead. *Taps*, not given. *Meters*, Worthington, 75. *Hydrants*, (in '83), 435.

Consumption, about 9,000,000 galls. *Pressure*: Ordinary, 55 lbs.

Financial.—Cost, to '83, $750,000. Debt, to '83, $451,000. Int., not given. Ann. op. exp., $34,000. Ann. rev: consumers, $95,000.

Management.—Comr., Jno. E. Cowles. Supt., Robt. Hawkins. Supt. pipes, Jas. Wallace.

NOTE:—A description of the construction of the intake pipe and crib is given in *Engineering News*, vol. XXI., pp. 26-28.

JACKSONVILLE, *Morgan Co.* (Pop., 10,927; est., 12,000.) On Mauvaisterre creek. Has manufactories.

History.—Built in '73-4 by city. Des. Engr., E.S. Chesbrough. Const. Engr., E. Wolcott.

Water Supply.—Surface water, pumping from impounding to distributing reservoir and direct. The surface water is from 4 sq. m. of rolling prairie, under cultivation. A supply from artesian wells has been proposed.

Dam.—Across ravine to form impounding reservoir; of earth, 18 ft. high, length not given.

Impounding Reservoir.—Cap., 80,000,000 galls. The site was excavated, and when full the reservoir is in no place less than 12 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Worthington duplex pumps. There were formerly two direct-acting pumps built by Chas. B. Hardwick, each having 26-in. steam and 14-in. water cylinders, the stroke of one having been 36, and of the other, 22 in.

Distributing Reservoir.—Cap., 2,500,000 galls.; is 86 ft. above the city and 133 ft. above the pumps; circular, with earth embankments, and has inner slopes and bottom lined with clay and paved with brick.

Distribution.—*Mains*, 4 to 10-in. c. i., 13½ miles. *Services*, lead. *Taps*, 346. *Meters*, 186. *Hydrants*, Ludlow, Galvin, 88. *Valves*, Ludlow, Galvin.

Consumption, about 400,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, $200,000. Debt, $105,500. Int., 6%. Ann. op. exp., $4,600. Ann. rev.: consumers, $8,812; city, none.

Management.—Three Comrs. Secy., Miss F. B. Fry. Supt., D. C. Fry. Engr.-in-Charge, Alex. Armstrong.

JOLIET, *Will Co.* (Pop., 11,657; est., 25,000.) On bluffs on Des Plaines river, which falls 36 ft. here, affording water power. Has large stone quarries, Bessemer Steel Works, and other manufactories. Settled in '30; incorp. a city in '53.

History.—Built in '80-1 by Joliet Water Works Co. The franchise was granted to Jesse W. Starr, who had charge of construction. The franchise provided that five streams of water should be thrown from hydrants, simultaneously, to a height 100 ft. When the works were completed and tested this could not be done, and it being claimed that other requirements, also, had not been fulfilled the city revoked the franchise and contracts. This action resulted in seven years of litigation, the case going from the lowest to the highest courts of the country, and always being decided in favor of the company.

In '88 the city purchased the works, the price having been determined by three arbitrators: A. Gottlieb, Chicago, for the company; L. B. Jackson, for the city; and T. J. Whitman, St. Louis, Mo., chosen by the two first. Terms of purchase are not given.

Water Supply.—Pond and artesian wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Knowles and Holly-Gaskill pumps.

Stand-Pipe.—Is 7 ft. in diam., and 145 ft. high.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky. *Taps*, 400. *Meters*, (in '86,) 365. *Hydrants*, Chapman, 60.

Consumption, 900.000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $186,620. Debt, $136,000. Int., 5 %. Ann. op. exp., $4,000. Ann. rev.: consumers, $7,000.

Management.—Not given. Report by J. D. Paige, Mayor.

KANKAKEE, *Kankakee Co.* (Pop., 5,651: est., 8,000.) On Kankakee river, which furnishes water-power. Engaged in manufacturing and trade.

History.—Built in '86-7 by Kankakee Water Co. Moffet, Hodgkins & Clarke, Watertown, N. Y., control the company, and acted as Contrs., with C. F. Taylor, as Const. Engr. The franchise is for 20 years.

Water Supply.—Kankakee river, filtered, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Gordon & Maxwell pumps and tubular boilers.

Filter.—Not described.

Stand-Pipe.—Is 20 ft. in diam. by 124 ft. high. Made by Sharon, (Pa.) Boiler-Works.

Oct. 14, '86, a week after the stand-pipe was completed, and before it was filled, it was blown down by a heavy gale. It was estimated that the wind blew 60 miles an hour. The pipe was in the highest part of the city. Its foundation was of stone in cement, 22 ft. in diam. The pipe consisted of 31 rings of boiler iron, each 4 ft. high, "thoroughly rivetted." The bottom rings were 11-16, and the two top, 5-32 in. thick. Six 2-in. anchor irons, 8 ft. long, were fastened to the masonry foundations, and to heavy cast-iron plates on the sides of the pipe. When the pipe fell some of the anchors pulled out of the masonry, and one broke below the nut at the upper end, and one in the masonry.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. *Taps*, 500. *Meters*, none. *Hydrants*, kind not given, 110.

Consumption, 250,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $160,000. Debt, $125,000. Int., 6%. Ann. op. exp. and rev.: withheld. Hydrant rental, $5,000, or about $45 each.

Management.—Prest., Henry C. Hodgkins, Watertown, N. Y. Secy., Henry Armstrong. Treas., Frank Watts. Supt., Wm. S. Reed. Pumping Engr., Edward Van Wirt.

KEWANEE, *Henry Co.* (Pop., 2,704; est., 4,300.) Engaged in coal mining and manufacturing.

History.—Built in '87-8 by village. Engr., Jno. A. Cole, Chicago. Contr. for masonry, Chas. Foerder & Co., Kewanee; for buildings, H. L. Dickinson, Galva.

Water Supply.—Well, 12 ft. in diam. and 31 ft. deep, by direct pumping, and pumping to storage reservoir for fire protection.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; a 1,000,000 and a 500,000-gall. Buffalo duplex pump, and a Haxteen boiler. Furnished by Pond Engineering Co., St. Louis, Mo.

Reservoir.—Contr., Aug. Wagner, Kewanee.

Distribution.—*Mains*, Kalamein i., 2½ miles. *Services*, Kal. i. Pipe and specials furnished by National Tube Works Co., Chicago. *Taps*, not given. *Meters*, none. *Hydrants*, Ludlow, 24. *Valves*, Walker.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, $30,000. Debt, $24,000. Int., 6%. Ann. op. exp. and rev., not determined.

Management.—Supt., B. F. Baker.

LAKE VIEW, *Cook Co.* (Pop., 6,565; est., 45,600.) A suburb of Chicago.

History.—Built in '75-6 by city. Engrs., Jno. A. Cole and J. W. Alvord, Ashland Block, Chicago. Contrs, for masonry and buildings, Loeffler & Co., Lake View.

Water Supply.—Lake Michigan, by direct pumping and pumping to tanks.

Intake-Pipes.—Of wrought iron, one 16-in. in diam., and extending 1,700 ft. into the lake, and one 20-in. in diam, extending 2,000 ft. In addition there is a shore inlet for use in case of emergency from fire or anchor ice. The submerged pipes have flexible joints, and terminate at the shore end in the pump-well, and at the lake end in a wrought-iron crib, 16 ft. sq. The dy. cap. of the submerged pipe is 8,000,000 galls.

Proposed Tunnel.—Plans have been prepared by Samuel G. Artingsall, Chicago, for a brick tunnel 9 ft. in diam., extending into Lake Michigan 6,000 ft. to 25 ft. of water. A concrete and masonry inlet crib will be built, 75 ft. in diam. and extending 15 ft. above water level. This will have an interior well 30 ft. in diam., with four 4-ft. apertures at the bottom connected with the lake.

The inlet crib will be surmounted by a cluster of incandescent electric lights 80 ft. above the water, operated by dynamos at the pumping station, connected by a cable in the tunnel. The estimated cost of the whole work is $224,500.

Pumping Machinery.—Dy. cap., 19,500,000 galls.; new 12,000,000-gall. Holly-Gaskill pump, and Worthington and Flanders pumps.

Tanks.—Two, 12 and 15 ft. in diam., respectively, with their bottom 16 ft. below average lake level.

Distribution.—*Mains*, c. i., 80 miles. *Services*, lead. *Taps*, 600. *Meters*, Worthington, number not given. *Hydrants*, "Wood's [Mathews] preferred." number not given.

Consumption, 6,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 70 lbs. (?)

Financial.—Cost, $500,000. Bonded debt, $150,000. Int., 4 to 7%. Ann. op. exp., $50,000. Ann. rev.: consumers, $60,000.

Management.—Comr. Public Works, Edgar Sanders. City Engr., H. C. Leach.

LEMONT, *Cook Co.* (Pop., 2,108; est., 4,500.) Is 25 miles from Chicago. Has large limestone quarries.

History.—Built in '84 by village, the artesian well being rented. Engr., Jas. B. Kelly. Contr. for masonry and buildings, Martin Sanber.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 150,000 galls.; two Smith & Vaile pumps, and horizontal boiler.

Reservoir.—Cap., about 100,000 galls.; of stone at an elevation of 100 ft. The village proposed to build a similar reservoir in '88 at an elevation of 160 ft.

Distribution.—*Mains*, 4 in. c. i., 5 miles. *Services*, lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville Ky. Trenching and pipe-laying done by Jno. Branky. *Taps*, 200. *Meters*, none. *Hydrants*, Mathews, 25. *Valves*, Eddy.

Consumption, 80,000 galls.; *Pressure*: Ordinary, 45 lbs. Fire, 70 lbs.

Financial.—Cost, $20,000. Debt, $2,500. Int., 6%. Ann. op. exp., $12,000. Ann. rev.: consumers, $1,600; city, none.

Management.—Village Prest., D. C. Norton.

LEWISTON, *Fulton Co.* (Pop., 1,771; est., 2,000.) Is 9 miles northwest of Chicago.

History.—Built in '88 by Lewiston Water Co., in which the town has an interest. Engr., Geo. C. Morgan, Chicago. Contrs. for masonry, J. W. Bradley & T. M. Mercer, Lewiston; for buildings, J. W. Bradley.

Water Supply.—Driven well, pumping to stand-pipe.

Pumping Machinery.—Knowles pump, dy. cap. not given.

Stand Pipe.—Cap., 25,000; 12 ft. in diam. and 36 ft. long.

Distribution.—*Mains*, 8 to 4-in. c. i., 5¼ miles; furnished by Lake Shore Foundry, Cleveland, O. *Hydrants*, from National Tube Works Co., Chicago. 23.

Pressure: Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—Cost, $30,000. Bonded debt, $15,000. Int., 6%.

Management.—Prest., Henry Phelps. Secy., H. C. Hassen. Report by Geo. H. Linton, City Clerk.

LINCOLN, *Logan Co.* (Pop., 5,639; est., 8,500.) On Salt creek, in coal region. Engaged in manufacturing.

History.—Built in '86 by Lincoln Water-Works Co., which is controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y. The franchise is for 30 years.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 750,000 galls.; two compound duplex condensing Gordon & Maxwell pumps.

Stand-Pipe.—Cap., about 130,000 galls.; 16 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i., lead. *Taps*, 183. *Meters*, 4. *Hydrants*, Galvin, 50. *Valves*, Scott.

Consumption, 160,000 galls. *Pressure*: Ordinary, 69 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Debt, $85,000. Int., 6%. Ann. op. exp. and rev., withheld. Hydrant rental, $60.

Management.—Prest., J. F. Moffett, Watertown, N. Y. Secy., Frank Watts. Supt., A. J. Aldrich.

LINCOLN PARK, *in the city of Chicago.*

General Description.—Water for use in the park is pumped from Lake Michigan by two Deane pumps with a dy. cap. of 2,000,000 galls. About 1,000,000 galls. are used each day. There are four miles of 6 to 4-in. cast-iron mains, and ¾-in. service pipes are used. Wm. P. Walker is Supt., of the Park.

LITCHFIELD, *Montgomery Co.* (Pop., 4,326; est., 6,000.) On level ground. Manufactures railway cars, machinery and flour. Settled in '54; incorp. a city '59.

History.—Built in '74 by town. It is unofficially reported that the bonds issued by the town to pay for the works were beyond the legal limit, 5% of its assessed valuation, and that after a time the city defaulted and failed to pay the interest on them. Also that the bondholders were defeated in a suit that terminated in the U. S. Supreme Court, the judgment being that the bonds were worthless. As late as '82 no payments were being made on the original bonded debt of $50,000, at 8%.

Water Supply.—Shoal creek, by direct pumping from impounding reservoir. The creek has a drainage area of about 20 sq. m.

Dam and Reservoir.—The dam is of earth, and the reservoir covers 24 acres.

Pumping Machinery.—Dy, cap., 1,000,000 galls.; Holly and Worthington pumps.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, (in '86,) 100. *Meters*, none. *Hydrants*, Ludlow, White, 31.

Consumption, 225,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost, $75,000. Bonded debt, see History. Ann. op. exp., $3,500. Ann. rev.: total, about $3,500.

Management.—Mayor, Henry Tuttle. Report by Melvin Madison.

LOCKPORT, *Will Co.* (Pop., 1,679; est., 3,500.) Is 5 miles from Joliet. Manufactures flour and paper.

History.—Built in '77 by Lockport Artesian Well Co.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery.—Water-power pump, dy. cap., 140,000 galls.

Reservoir.—Cap., about 500,000 galls.; 40 by 90 ft., by 20 ft. deep.

Distribution.—*Mains*, iron, 1 mile. *Services*, lead. *Taps*, 60. *Meters*, none. *Hydrants*, Mathews 20. *Valves*, Eddy.

Consumption and *Pressure*, not given.

Financial.—Cost, $500. Capital stock, $3,000. No debt. Ann. op. exp., $500. Ann. rev.: consumers, $450; city, $50.

Management.—Prest., J. L. Norton. Secy., W. G. Norton.

LOSTANT, *La Salle Co.* (Pop., 363; est., 500.)

General Description.—A small system was built in '88 by village, at a cost of

$2,000. Water is pumped from a well to a tank. No debt. Village Clerk, C. P. Adams.

MATTOON, *Coles Co.* (Pop., 5,737; est., 7,000.)

History.—Built in '85 by Mattoon Clear Water Co.

Water Supply.—Well, pumping to tank and direct. The Cook Well Co., St. Louis, Mo., has a contract for increasing the supply.

Pumping Machinery.—Not described.

Tank.—Not described.

Distribution.—(In '86.) *Mains*, c. i., 6.2 miles. *Services*, w. i. *Taps*, 70. *Meters*, none. *Hydrants*, 73.

Consumption, 35,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 150 lbs.

Financial.—(In '86.) Cost, $70,000. Debt, $65,000. Int., 6%. Ann. op. exp. and rev., not given. Hydrant rental, about $70.

Management.—Address H. S. Clark.

MENDOTA, *La Salle Co.* (Pop., 4,142; est., 5,000.) Manufactures organs, flour and carriages.

History.—Built in '88, and put in operation Jan. 1, '89, by town. Engr., Geo. C. Morgan, Chicago, who acted as purchasing agent for the town.

Water Supply.—Artesian well, 400 ft. deep, pumping to reservoir, and thence to tank.

Pumping Machinery.—Dy. cap., 750,000 galls.; a deep-well and a high-pressure pump, the latter being a Deane.

Reservoir.—Cap., 144,000 galls.

Tank.—Cap., 30,000 galls.; placed on Morgan's special tower, 118 ft. high.

Distribution.—*Mains*, c. i., 2 miles. *Hydrants*, Morgan, 18. *Valves*, Crane.

Management.—Mayor, J. A. Lamberton. Chairman Water Board, D. L. Harris.

NOTE:—Other data not determined.

MENONK, *Woodford Co.* (Pop., 1,913; est., 3,000.) Has flouring mill, coal mine and tile works.

General Description.—Built in '87 or '88 by village at a cost of $10,000. Bonded debt, $10,000. Contrs., Fairbanks, Morse & Co., Chicago. City Clerk, A. J. Taylor.

MOLINE, *Rock Island Co.* (Pop., 7,800; est., 10,000.) On Mississippi river, on bottom lands about 1½ miles wide, with bluffs back of them 150 ft. high. Has water-power and manufactories. Settled in '43; incorp. a village in '53, and a city in '72.

History.—Built by city in '73, after plans by City Engr., M. A. Gould.

Water Supply.—Mississippi river, by direct pumping. Water passes from a pool, formed by a dam across the channel of the river, through a conduit to a settling basin; thence by direct pumping.

Dam.—Built from the Illinois shore to Rock Island by the U. S. Government. Of stone, 4,000 ft. long, 20 ft. high, 8 ft. wide at bottom and 4 at top, with buttresses.

Conduit.—From pool to settling basin; of 2-in. pine plank, 14 by 36 in. and 1,000 ft. long.

Settling Basin.—Not described.

Pumping Machinery.—Dy. cap., 2,500,000 galls. Deane pumps and two 5 by 16-ft. tubular boilers. A Knowles and a Worthington pump were successively removed on account of increasing demand for pumping capacity.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 300. *Meters*, 20. *Hydrants*, kind not given, 120.

Consumption, 700,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 140 lbs.

Financial.—Cost, $95,000. Debt, $50,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $6,500; city, none.

Management.—Supt., Fred Alstulund.

MONMOUTH, *Warren Co.* (Pop., 5,000; est., do.) Engaged in manufacturing.

History.—Built in '88-9 by city. Engr., W. W. Curtis, St. Paul, Minn. Contr. for buildings, J. M. Logan, Monmouth.

Water Supply.—Flowing artesian well, by direct pumping at present. A tank may be put in.

Reservoir.—Cap., 300,000 galls.; Contrs.; Rockford Const. Co.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; non-compound duplex Holly pump. Boiler from —— Fawcett, Burlington, Ia.

Distribution.—*Mains*, 6 to 10-in. c. i., 3¾ miles; furnished and laid by Rockford Const. Co. *Hydrants*, Bourbon, 34.

Pressure: Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $32,000. Bonded debt, $32,000. Int., 5%.

Management.—Chairman Com., W. W. McCullough.

MORGAN PARK, *Cook Co.* (Pop., 187; est., 1,500.)

History.—Built by village in '74. Engr., C. McLennan.

Water Supply.—Artesian well, pumping to tank. Formerly an open well 40 ft. deep was drawn from. The new well was bored by W. H. Gray.

Pumping Machinery.—Dy. cap., 72,000 galls.; Deane pump. Boilers were furnished by M. H. Walker & Co. The first pump was a double-acting force pump with 5-in. plunger and 15-in. stroke, driven by a 25-ft, windmill: the latter was made by the U. S. Wind Engine & Pump Co.

Tank.—Cap., 100,000 galls.; Contrs., Fairbanks, Morse & Co., Chicago. The first tank had a cap. of 50,000 galls., was 24 ft. in diam. and 14 ft. high, placed on a timber trestle 24 ft. high.

Distribution.—*Mains*, wood and iron, 8 miles. *Services*, not given. Pipe furand laid by C. S. Baker & Co. *Taps*, 80. *Meters*, none. *Hydrants*, Ludlow, 4. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 40 lbs.

Financial.—No data given.

Management.—Comrs.: A. Wiswall and H. E. Thayer. Supt., W. S. Myrick.

MORRISON, *Christian Co.* (Pop., 1,981; est., 2,000.)

History.—Built in '69 and rebuilt or extended in '82 by town. **Engr.** of latter work, H. G. Parish.

Water Supply.—Spring, pumping to tank, and direct in case of fire.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington pumps and tubular boilers.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 250. *Meters*, none. *Hydrants*, Mathews, Ludlow, 33.

Consumption, 200,000 galls. *Pressure*: Ordinary, 28 lbs. Fire, 155 lbs.

Financial.—Cost, $23,000. Debt, $8,506. Int., 5%. Ann. op. exp., $2,200. Ann. rev.: consumers, $2,258; city, none.

Management.—City Council. Supt., H. G. Parish.

MORRISONVILLE, *Christian Co.* (Pop., 748; est., 1,100.) Has manufactories.

History.—Built in '88 by village. Engr., "for certain parts," F. Wm. Raeder, St. Louis, Mo. Labor done by the day.

Water Supply.—Well, pumping to tank and direct. The well was built by the village independently of other work.

Pumping Machinery.—Dy. cap., 500,000 galls.; duplex pump. Pump and boiler furnished by N. O. Nelson Co., St. Louis, Mo.

Tank.—Cypress, 20 ft. in diam., and 16 ft. high, on 60-ft. wooden trestles.

Distribution.—*Mains*, 8 to 4-in. c. i., 1,400 ft.; furnished by Shickle, Harrison & Howard Iron Co., St. Louis. No taps or meters yet. *Hydrants*, Ludlow, 4. *Valves*. Ludlow.

Consumption, no regular amount. *Pressure*: Ordinary, 33 lbs. Fire, 60 to 75 lbs.

Financial.—Cost, $7,000. Bonded debt, $7,000. No revenue.

Management.—Village Clerk, W. E. Forbes.

MOUNT CARROLL, *Carroll Co.* (Pop., of township, 2,878; village, est., 2,000.)

General Description.—Built in '88 by Village. Contrs., U. S. Wind Engine & Pump Co. Batavia, Ill. Water is pumped from a well to an elevated tank. Cost, $18,000. Bonded debt, $18,000. City Clerk, Don. R. Frazer.

MOUNT PULASKI, *Logan Co.* (Pop., 1,125; est., 2,100.)

History.—Built in '82 by village, under the direction of J. M. Hopkins, the Supt.,

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Cap., 350,000 galls.; Hooker Colville pump.

Tank.—Cap., about 50,000 galls.

Distribution.—*Mains*, 3 miles. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Nelson, 21.

Consumption, 130,000 galls. *Pressure*: 35 lbs.

Financial.—Cost, $4,500. No debt. Ann. op. exp., $1000. Ann. rev.: consumers, $600; city, none.

Management.—Chairman of Comrs., Jno. T. Schick. Supt., J. M. Hopkins.

OAK PARK, *Cook Co.* (Pop., 1,888; est., 5,000.) Is 5 miles west of Chicago.

History.—Built in '85 by Cicero Water, Gas & Electric Light Co. Engr., Geo. C. Morgan, Chicago. Labor done by the day.

Water Supply.—Two artesian wells, 2,000 ft. deep, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., 1,500,000 galls.

Stand-Pipe.—Diam. not given, 105 ft. high.

Distribution.—*Mains*, iron, 9 miles. *Services*, lead. *Taps*, 200. *Meters*, 76. *Hydrants*, Mathews, 85. *Valves*, Crane.

Consumption, 30,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, 65,000. Capital stock, $170,000. Bonded debt. $30,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $4,000; city, no contract yet made.

Management.—Prest., J. W. Scoville. Vice Prest., E. S. Conway. Secy., C. E. Simmons. Treas., O. W. Herrick. Supt., F. W. Jackson. Pumping Engr., Jas. Henry.

OREGON, *Ogle Co.* (Pop., 1,088; est., 2,000.) On Rock river. Has some manufactories, and is a summer resort.

History.—Built in '78 by village.

Water Supply.—Rock river, pumping to reservoir.

Pumping Machinery.—Blake pumps, dy. cap., 250,000 galls.

Reservoir.—Cap., 1,120,000 galls.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 75. *Meters*, 5. *Hydrants*, Holly, 21. *Valves*, Eddy.

Consumption, 25,000 galls. *Pressure*, 85 lbs.

Financial.—Cost, $18,012. No debt. Ann. op. exp., $500. Ann. rev.; consumers, $550; city, none.

Management.—Fire and Water Com. of three. Supt., Wm. H. Sears. Report E. W. Blackstone.

OTTAWA, *La Salle Co.* (Pop., 7,834; est., 10,000.) On Illinois, at mouth of Fox river. Has water-power, and manufactures glass goods, fire-brick, drain tile and pottery.

History.—Built in '60 by private company, for the use of manufactories, the surplus going to business houses. In '88 the works were extended for fire protection.

Water Supply.—Springs, by gravity.

Reservoir.—Is 9 by 15 ft., by 15 ft. deep.

Distribution.—*Mains*, c. i. 4 miles. *Services*, w. i. *Taps*, 125. *Meters*, none. *Hydrants*, not determined.

Consumption, 180,000 galls. *Pressure*: not given.

Financial.—Capital stock, $100,000. No further data given.

Management.—Prest. and Supt., J. D. Caton. Secy., C. A. Caton.

PARIS, *Edgar Co.* (Pop., 4,373; est., 5,000.) Is 19 miles from Terre Haute. Engaged in manufacturing.

History.—Built in '79 by the city. Engr., J. G. Briggs, Terre Haute.

Water Supply.—Ground water, by direct pumping from reservoir. It is unofficially reported that a later supply has been obtained from driven wells, and a second reservoir built.

Reservoir.—Cap., 4,000,000 galls.; excavated in clay and quicksand, with an area of 1½ acres. A well 8 ft. in diam. and sunk for 6 ft. below the bottom of the reservoir receives the suction pipes.

Pumping Machinery.—Dy. cap., not given; two duplex high-pressure Blake pumps, with 18-in. steam and 10-in. water cylinders of 24-in stroke.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, not given. *Taps*, 125. *Meters*, none. *Hydrants*, Mathews, 56.

Consumption, not given. *Pressure*: 30 to 120 lbs.

Financial.—Original cost, $39,706. Bonded debt, $30,000. Int., not given. Ann op. exp., $2,049. Ann. rev.; consumers, $872.

Management.—City Clerk, A. H. Geohegan.

NOTE:—No report has been given since '83.

PARK RIDGE, *Cook Co.* (Pop., 457; est., 800.) Is 15 miles from Chicago.

History.—Built in '87 by village, making use of a well sunk in '75-6. Engr. and Contr., Geo. C. Morgan, Chicago.

Water Supply.—Artesian well about 1,500 ft. deep, pumping to tank. The well is lined for 200 ft. with 6, and for 600 ft. with 3½-in. pipe. Water stands about 8 ft. below the surface.

Pumping Machinery.—Deane duplex pump, dy. cap., 150,000 galls. A small Worthington pump was used for a time, but became insufficient.

Tank.—Cap., 30,000 galls.; Morgan's special tower, consisting of an iron tank on a brick substructure.

Distribution.—*Mains*, 6 and 4-in. Wyckoff wood, 2,540 ft. *Services*, not given. *Taps*, 30. *Meters*, none. *Hydrants*, Morgan, 3. *Valves*, Crane.

Consumption, 2,000 galls. *Pressure*; Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $6,000. Debt, $2,500. Int., 6%. Ann. op. exp., $600. Ann. rev.: consumers, $450.

Management.—Secy. of Com., Saml Cochran. Supt., S. E Cummings.

PAXTON, *Ford Co.* (Pop., 1,725; est., 2,500.)

History.—Built in '87-8 by village. Contrs., Fairbanks, Morse & Co., Chicago, with P. D. Johnson as Supt. of Const.

Water Supply—Artesian well, pumping to tank.

Puming Machinery.—Dy. cap., 40,000 galls.

Tank.—Cap., 60,000 galls.; 18 by 24 ft., on tower 80 ft. high.

Distribution.—*Mains*, wood, 1,200 ft. *Services*, iron. *Hydrants*, Beaumont, 4. *Pressure*: Ordinary, 45 lbs.

Financial.—Cost, $8,500. Bonded debt, $3,500. Int., 7%.

Management.—Not given. Report by J. P. Widdlecoff.

PEKIN, *Tazewell Co.* (Pop., 5,993; est., 7,000.) On Illinois river, 10 miles below Peoria.

History.—Built in '86 by Pekin Water-Works Co. Engr., E S. Alexander, Chicago. Contrs., Lamb & Raymond, Chicago.

Water Supply.—Driven well, pumping to tank.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Blake pump, and 5 by 16-ft. boiler.

Tank.—Is 20 by 55 ft., on 80 ft. of masonry.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps*, 300. *Meters*, 2. *Hydrants*, Ludlow, 111. *Valves*, Ludlow.

Consumption, 115,000 galls. *Pressure*; Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $5,000; city, $4,385.

Management.—Prest., Geo. H. Lucas. Secy. and Supt., Henry Lautz.

PEORIA, *Peoria Co.* (Pop., 29,259; est., 45,000.) On Illinois river, on high ground surrounded by bluffs. Permanently settled in '19.

History.—Built in '67-8 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Illinois river, by direct pumping.

Pumping Machinery.—Dy. cap., 3 500,000 galls.; Deane, Cameron, high and low pressure Worthington pumps. Two Holly rotary pumps were used at first.

Distribution.—*Mains*, c. i., 47 miles. *Services*, lead. *Taps*, 3,000. *Meters*, 35. *Hydrants*, Holly, Ludlow, Chapman, Galvin, 338.

Consumption, 3,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 180 lbs.

Financial.—Cost, $450,000. Debt, $450,000. Int., 6%. Ann. op. exp., $32,000. Ann. rev.; consumers, $35,000; city, none.

The op. exp., for '80 were $19,989, and the rev., $24,805.

Management.—Com, of three. Supt., Frank M. Loughlin.

PETERSBURG, *Menard Co.* (Pop., 2,332; est., 2,500.) On Sangamon river.

History.—Built in '87-8 by village, the committee modifying plans made by W. R. Coats, Kalamazoo, Mich. Contr., D. Fisher.

Water Supply.—Four 8-in. tube wells, pumping to tank.

Pumping Machinery.—Buffalo pump, dy. cap., 500,000 galls.

Tank.—Cap., 58,000 galls.; 20 ft. in diam, and 30 ft. high.

Distribution.—*Mains*, 10 to 4-in. c. i., 1½ miles. *Services*, not given. *Taps*, 40. *Meters*, none. *Hydrants*, Bourbon, 19. *Valves*, Bourbon.

Consumption, 50,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $22,418. Debt, $19,000. Int., 5%. Ann. op. exp., est., $1,000. Ann. rev.: consumers, est., $1,000.

Management.—Com.: Messrs Eastman, Longford & Walker. Report by S. F. Eastman.

PINCKNEYVILLE, *Perry Co.* (Pop., 964; est., 1,600.) On Beaucoup creek. Engaged in coal mining, and in manufacturing carriages, plows and timber.

General Description.—Being built in '88-9 by village, taking water from a pond formed by damming a stream. Est. cost, $8,000. Debt, $6,000. Int., 6%. Mayor, J. L. Murphy. Report by Ed. L. Hayes.

PITTSFIELD, *Pike Co.* (Pop., 2,104; est., 3,000.) Has manufactories.

History.—Built in '87-8 by town. Des. Engr., Geo. C. Morgan. Const. Engr., Chester B. Davis, under the immediate direction of Scott Myrick. All of Chicago. Labor done by the town.

Water Supply.—Surface well, with artesian well sunk from its bottom, pumping to tank. Contrs. for artesian well, Laney & Churchill, Indianapolis, Ind.

Pumping Machinery.—Not given; a temporary pump was used, 3½ in. in diam., of 42 in. stroke.

Tank. — Iron, 15 ft. in diam. and 36 ft. high; on 68-ft. tower. Contr., Wm. Drake, Springfield.

Distribution.—*Mains*, 8 and 6-in, furnished by Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Hydrants*, 10.

Pressure: 50 lbs.

Financial.—Cost., est., $15,000. Debt, $4,000. Int., 7%.

Management.—Com. of three. Report by Scott Wike.

POLO, *Ogle Co.* (Pop., 1,819; est., 2,200.)

General Description.—Water is supplied for fire protection from the tank of the Ill. Central R. R. Co., through pipe on Main St. and three hydrants. Mayor, W. W. Pierce.

PRINCETON, *Bureau Co.* (Pop., 3,439; est., 4,000.) Engaged in manufacturing and coal mining.

Proposed System.—An artesian well is being sunk by J. P. Miller of Chicago, and when water is found definite plans will be made regarding water-works. The sum of $5,000 was appropriated for the well. City Clerk, I. O. Brokaw.

PULLMAN, *Cook Co.* (Pop., est., 10,500.) In village of Hyde Park, and consists of shops and factories and dwellings, all of which are owned by the Pullman Palace Car Co.

History.—Built in '80-2 by Pullman Palace Car Co. Engr., Benezette Williams.

Water Supply.—Hyde Park water-works, they pumping to a tank in Pullman through 6 miles of mains. The water is metered.

Tank.—Cap., 500,000 galls.; 56 ft. in diam. and 31 ft. deep, placed on a tower.

Distribution.—*Mains*, c. i., 15 miles. *Services*, lead. *Taps*, 1,750. *Meters*, 125. *Hydrants*, Bailey, Ludlow, 166. *Valves*, Eddy, Ludlow.

Consumption, 1,250,000 galls. *Pressure*: 75 lbs.

Financial.—Cost, $140,009. No debt. Ann. op. exp., about $14,000. Ann. rev.: about $22,000.

Management.—Pullman Palace Car Co., with D. Doty as Supt. of the water-works.

QUINCY, *Adams Co.* (Pop., 27,268; est., 36,000.) On magnesian limestone bluffs 165 ft. above the Mississippi river. Engaged in manufacturing and trade. Settled in '21; incorp. a city in '40.

History.—Built in '73 by private company and now owned by L. & W. B. Bull. Des. Engr., Edw. Prince.

A suit brought by the company against the city for a debt of $48,000 was decided against the former in the Supreme Court, on the ground that the city had no right to contract the debt, as it had exceeded the limitation of 5 per cent. on the value of taxable property. The final settlement is not reported.

Water Supply.—Mississippi river, pumping to reservoir.

Intake Pipe.—Of 30-in. cast-iron, extending to a depth of 13 ft. of water. A 20-in. pipe was used until the present one was laid in '78.

Pump-Well.—Lined with brick and cement, and extends to rock; its bottom is covered with 1 ft. of cement mortar. In '82 the pump-well in use was 30 ft. in diam., double-walled. Water passed through a wire screen around three-fourths of the outer annular space to the inner well. It is not stated whether the new intake was connected with this well.

Pumping Machinery.—Dy. cap., 6,500,000 galls.; 5,000,000-gall. Gordon & Maxwell, and 1,500,000-gall. Worthington pump, the latter being a compound duplex.

Reservoir.—Cap., 22,000,000 galls. Water was first pumped to two tanks having a combined cap. of 150,000 galls. In '77 a 5,000,000-gall. reservoir was built, and in '82 the one now in use, which is 235 ft. above the pumps, 250 by 412 ft., by 26 ft. deep, and in excavation and embankment. The banks are from 90 to 110 ft. thick at the base, 27 at the high-water mark, and 15 ft. at the top. The banks were built up in 6-in. layers, the inner slopes and the bottom are puddled, and the inner slopes are paved with a 16-in. dry stone wall. The effluent pipe has flexible joints.

Distribution.—*Mains*, c. i., 20 miles. *Services*, galv. 1. *Taps*, 1,150. *Meters*, 175. *Hydrants*, Mathews, 150. *Valves*, Ludlow, Galvin.

Consumption, 671,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 35 lbs.

Financial.—Cost, $45,000. No stock, bonds or debt. Ann. op. exp., withheld, but est., $15,000. Ann. rev.: withheld, but est., $25,000; city, $10,000.

Management.—Supt., Wm. B. Bull.

ROCHELLE, *Ogle Co.* (Pop., 1,893; est., 2,000.) On Kaite river in rolling country.

History.—Built in '73 by village. Des. Engr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Spring in an abandoned quarry, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington pump and two 75 H. P. horizontal tubular boilers.

Distribution.—*Mains*, c. i., 2.3 miles. *Services*, w. i., lead. *Taps*, 40. *Meters*, none. *Hydrants*, Holly, 37. *Valves*, Peet.

Consumption, unknown. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $22,000. No debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $650; city, none.

Management.—Comm. of three. Supt., Ed. E. Spooner.

ROCK FALLS, *Whiteside Co.* See Sterling.

ROCKFORD, *Winnebago Co.* (Pop., 13,129; est., 22,500.) On both sides of Rock river, which at this point is crossed by a dam 6 ft. high built for water-power. Engaged in manufacturing. Settled in '34; incorp. a city in '52.

History.—Built in '74-5 by city. Des. Engr., Birdsall Holly, Lockport, N. Y. Const. Engr., S. P. Crawford, Rockford. Labor done by the city.

Water Supply.—Five artesian wells, by direct pumping. The wells take their supply from the Potsdam sandstone, and are from 1,300 to 2,000 ft. deep. The first one was sunk in '85, before which water was taken from Rock river through a filter 25 ft. in diam. This was filled with sand and charcoal, and passed 800,000 galls. a day, but did not work well. Before the artesian wells were put down a well 50 ft. in diam. and 45 ft. deep was sunk in gravel.

Pumping Machinery.—Dy. cap., 12,000,000 galls.; two 1,500,000-gall. Holly quadruplex, 3,000,000-gall. Holly-Gaskill and new pumps added in '88. There are three 5 by 16-ft. tubular boilers. The cost of raising 1,000,000 galls. 1 ft. was $0.13 in '88; the gross revenue per 1,000,000 galls. $30, and the net $12.66.

Distribution.—*Mains*, c. i., 35 miles. *Services*, w. i., lead. Pipe and specials furnished by R. D. Wood & Co., Philadelphia, Pa., and Dennis Long & Co., Louisville, Ky. *Taps*, none. *Hydrants*, Holly, Mathews, 250. *Valves*, Eddy, Galvin.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $354,935. Debt, $94,000. Int., 5 and 6%. Ann. op. exp., $11,500. Ann. rev.: consumers, $21,000; city, $13,200.

The op. exp. for '80 were $8,792, and the rev., $7,274.

Management.—Supt, Jno. T. Lakin.

ROCK ISLAND, *Rock Island Co.* (Pop., 11,659; est., 17,000.) On Mississippi river. Engaged in manufacturing, coal mining and trade. Settled in '30; incorp. a city in '49.

History.—Built in '71-2 by the city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Mississippi river, by direct pumping.

Intake.—Of 24-in. cast-iron pipe, extending from the main channel 2,100 ft. to a stone basin 30 ft. in diam. and 28 ft. deep, having a cross-wall with screens.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; old Holly rotary and gang pumps, with a dy. cap. of 2,000,000 galls., and 3,000,000-gall. Holly quadruplex erected in '82.

Distribution.—*Mains*, c. i., 17 miles. *Services*, w. i., lead. *Taps*, 1,200. *Meters*, none. *Hydrants*, Holly, Ludlow, Perkins, 112.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, $220,000. Debt, $50,000; $25,000 at 5 and $25,000 at 8%. Ann. op. exp., $8.000.; Ann. rev.: consumers, $15,000; city, none.

Management.—Supt., Morris T. Stafford.

SANDWICH, *De Kalb Co.* (Pop., 2,352; est., 3,000.) On level ground. Settled in '33; incorp. a village in '60, a city in '72.

History.—Built in '83 by city. Des. Engr., W. C. Brown.

Water Supply.—Well, pumping to stand-pipe and direct in case of fire. The well is in gravel, 14 ft. in diameter, 28 ft. deep, walled with brick in cement. It yields about 400,000 galls. a day.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington pump of 18½ in. steam and 10½ in. water cylinders of 10-in. stroke. The boiler is vertical and of 54 H. P.

Stand-Pipe.—Cap., 84,000 galls.; 12 ft. in diam. and 100 ft. high. On a masonry foundation 25 ft. in diam. at the base, 15 at the top, and 9 ft. thick. The pipe is from ¼ to 3-16-in. thick. Built by Excelsior Iron Works, Chicago.

Distribution.—*Mains*, Kalamein i., 3½ miles. *Services*, galv. i. Pipe furnished by National Tube Works, McKeesport, Pa. *Taps*, 80. *Meters*, 1. *Hydrants*, Ludlow, 32.

Consumption, 6,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 125 lbs.

Financial.—Cost, $25,000. Debt, $18,000. Int., 6%. Ann. op. exp., $700. Ann. rev.: consumers, $500; city, none.

Management.—Supt., L. D. Smith.

SAVANNA, *Carroll Co.* (Pop., 1,000; est., 3,500.) On Mississippi river.

History.—Built in '86 by town.

Water Supply.—Mississippi river, filtered, pumping to reservoir.

Filter.—Water passes through sand into large well or reservoir.

Pumping Machinery.—Deane pump, dy. cap., 700,000 galls.

Reservoir.—Cap., 700,000 galls.

Distribution.—*Mains*, Kalamein i., 3¼ miles. *Services*, w. i. *Taps*, 59. *Meters*, none. *Hydrants*, Ludlow, 18. *Valves*, Ludlow.

Consumption, 35,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 lbs.

Financial.—Cost, $20,000. Debt, $13,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $900; city, none.

Management.—Supt., W. H. Griffith. Clerk, F. S. Greenleaf.

SHELBYVILLE, *Shelby Co.* (Pop., 2,939; est., 3,500.) On Kaskaskia river in mining district. Has manufactories.

History.—Built in '85-6 by Shelbyville Water Co., under a 20 years' franchise. Des. Engr., S. H. Lockett, New York City. Const. Engr., J. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, New York City.

Water Supply.—Kaskaskia river, to infiltration well, thence pumping to stand-pipe and direct. A suction pipe connects directly with the river.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound duplex Worthington pumps, and two 50 H. P. Whittier tubular boilers.

Stand-Pipe.—Of boiler steel, 12½ ft. in diam. and 130 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 12 to 4-in. c. i., 7 miles. *Services*, c. i., lead. *Taps*, 153. *Meters*, 1. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 170,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 160 lbs.

Financial.—Capital stock and bonds, $100,000. Hydrant rental, $68. All further data withheld.

Management.—Prest., T. M. Thornton. V. Prest., F. J. Snow. Secy. and Treas. J. W. Maguire.

SOUTH EVANSTON, *Cook Co.* (Pop., 1,517; est., 3,000.)

History.—Built in '84 by village and extended or rebuilt in '88. Engr., Geo. C. Morgan, Chicago. Contr. for masonry and buildings, C. T. Bardell, Evanston.

Water Supply.—Lake Michigan through inlet pipe, pumping to tank. Water was formerly taken by gravity from a flowing artesian well 1,602 ft. deep,and 6-in. in diam. for 1,236 then 5 in. for 366 ft. Water rose 24 ft. above the surface.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Deane pumps, and steel flue boiler with 4 ft. shell.

Tank.—Cap.,30,000 galls.; Morgan's special water tower, having tank on a trestle.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps*, 225. *Meters*, 2. *Hydrants*, Chapman, 56. *Valves*, Chapman.

Consumption, 750,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 110 lbs.

Financial.—Cost, $50,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,700; city, none.

Management.—Chairman Water Board, P. E. O'Neil. Secy.,W. G. Norbett. Supt. and Pumping Engr., Jno. Watson.

SPRINGFIELD, *Sangamon Co.* (Pop., 19,743; est., 30,000.) On a prairie five miles from Sangamon river. Settled in '22; incorp. a city in '40.

History.—Built in '66 by city,and extended in '88. Des. Engrs., Henry Earnshaw, Cincinnati, O. Labor is done by the city.

Water Supply.—Sangamon river, through filter galleries, pumping to stand-pipe and reservoir. Water was first taken from the river to the pump-well through a conduit 80 ft. long. The supply becoming insufficient a well was sunk 50 ft. in diam. and 53 ft. deep, and in '88 a filter gallery or tunnel was built beneath the bed of the river.

Pumping Machinery.—Dy. cap., 4,250,000 galls.; one low and one high-pressure Worthington pump.

Stand-Pipe.—Is 3 ft. in diam. and 70 ft. high.

Reservoir.—Cap., 4,000,000 galls. In '77 1,300 cu. yds. of sediment was removed from the reservoir bottom.

Distribution.—*Mains*, c. i., 32 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 1,700. *Meters*, 50. *Hydrants*, Morgan, Chapman, Galvin, Ludlow, 148.

Consumption, 2,440,780 galls. *Pressure*: Ordinary, 15 to 25 lbs.

Financial.—Cost, about $550,000. Debt, $450,000. Int., 8%. Ann. op. exp., $22,219. Ann. rev.: total, $35,277.

Management.—Three Comrs. Prest., H. O. Bolles. Treas., Obed Lewis. Secy., H. A. Beecher. Supt., Peter Berriman. Pumping Engr., F. L. Wheatley.

STERLING AND ROCK FALLS, *Whiteside Co.* (Pop.: Sterling, 5,087; est., 6,500. Rock Falls, 894; est., 1,800.) On both sides of Rock river, which furnishes good water-power used in manufacturing.

History.—Built in '86 to supply Sterling, and extended to Rock Falls in '87 by Sterling Water Co. The franchise was for 20 years in each place. Des. Engr., A. H. Howland, Boston, Mass. Const. Engr., H. F. Dunham. Contrs. for works at Sterling, Eastern Construction Co. The labor at Rock Falls was done by the day, under the direction of H. F. Dunham.

Water Supply.—Artesian wells and Rock river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Deane pumps and Allen boilers.

Stand-Pipe.—Is 20 ft. in diam. and 100 ft. high; Contrs., Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 13½ miles, 1 mile being in Rock Falls. *Services*, w. i., lead. *Taps*, 360. *Meters*, none. *Hydrants*, Coffin, 132; 12 being in Rock Falls. *Valves*, Coffin. *Pressure-recording gauge*, Edson.

Consumption, 180,000 galls. *Pressure*: Ordinary, 40 to 60 lbs. Fire, 70 to 120 lbs.

Financial.—Cost, $275,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., about $11,000. Ann. rev.: consumers, $7,000; cities, $7,390. Hydrant rental, $56.

Management.—Prest., A. H. Howland, Boston, Mass. Treas., H. Butler. Secy., H. C. Ward. Supt., not given.

STREATOR, *LaSalle Co.* (Pop., 5,137; est., 15,000.) On Vermillion river in coal fields.

History.—Built in '86-7 by Streator Aqueduct Co., under a 30 years' franchise. Engrs. and Contrs., Goodhue & Birnie, Springfield, Mass.

In '82 the city sunk an artesian well 2,496 ft., reaching a vein of saline water in the Potsdam sandstone, which rose 40 ft. above the ground. About ½ mile of wooden pipe was laid and 6 hydrants set, the water being used for street sprinkling and fire protection.

Water Supply.—Tube wells and Ottar creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. Holly Gaskill pumps.

Stand-Pipe.—Is 20 ft. in diam. by 125 ft. high. Made by R. F. Hawkins, Springfield, Mass.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., and trenching and pipe-laying done by R. B. Carothers; both of Newport, Ky. *Taps*, 400. *Meters*, 14. *Hydrants*, Chapman, 122. *Valves*, Chapman.

Consumption, 250,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 130 lbs.

Financial.—Cost, $275,000. Capital stock, $175,000. Bonded debt, $175,000. Int., 6%. Ann. op. exp., withheld, but est., $10,000. Ann. rev.: consumers, withheld, but est., $15,000.; city, $5,400. Hydrant rental, $45 for 112, and $35 for each additional.

Management.—Prest., L. M. Bronson. Secy., T. M. Birnie. Supt., F. D. Ferguson.

SYCAMORE, *DeKalb Co.* (Pop., 3,028; est., 4,000.) Manufactures farming implements.

History.—Built in '76, and extended in '87 by village. Des. Engr., Chester B. Davis, Chicago.

Water Supply.—Surface well, pumping to stand-pipe and direct. The well is 25 ft. in diam. and 30 ft. deep. A 3-in. boring was made until water was found, and the well dug about this as a center.

Pumping Machinery.—Two Blake pumps; dy. cap., 30,000 galls.

Stand-Pipe.—Is 15 ft. in diam. and 135 ft. high. Contrs., Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 1¾ miles. *Services*, lead and iron. *Taps* and *Meters*, not given.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 120 lbs.

Financial.—Cost, $40,000. Bonded debt, $25,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: none.

Management.—Supt., Jno. B. Whalen.

TAYLORVILLE, *Christiana Co.* (Pop., 2,237; est., 3,000.) Has manufactories.

History.—Built in '86 by town. Engr., Geo. C. Morgan. Contractors for labor were local.

Water Supply.—Well, 30 ft. in diam. and depth, and tube wells, pumping to tank and direct. The tube wells were sunk in '88.

Pumping Machinery.—Deane high-pressure pumps, dy. cap., 3,000,000 galls.

Tank.—Cap., 30,000 galls.; Morgan's special water tower.

Distribution.—*Mains*, c. i., Wyckoff wood, 6½ miles. *Services*, not given. *Taps*, not given. *Meters*, none. *Hydrants*, Morgan, Ludlow, 39. *Valves*, Ludlow.

Consumption, $28,000. Debt, $17,000. Int., 6%. Ann. op. exp., $6,500. Ann. rev.: consumers, $1,100; city, none.

Management.—Report by Jno. Perry.

TOWN OF LAKE, *Union Stock Yards P.O., Cook Co.* (Pop., 18,380; est., 80,000.) A suburb of Chicago. Settled in '60; incorp. a town in '67.

History.—Built in '74-6 by Lake and Hyde Park, jointly. In '82 Hyde Park gave up its interest in the works. Engr., J. T. Foster. Labor done by the town.

Water Supply.—Lake Michigan, by direct pumping.

Intake-Pipe.—Of 30-in. cast-iron, 1,750 ft. long. In use in '82.

Pumping Machinery.—Holly pumps, dy. cap., 12,000,000 galls.; Holly quadruplex pumps of 9-in. bore and 24-in. stroke, and a Knowles pump of 20-in. bore and 36-in. stroke were used in '82.

Distribution.—*Mains*, c. i., 140 miles. *Services*, lead. *Taps*, 10,000. *Meters*, Worthington, (in '84,) 81. *Hydrants*, Holly, (in '84,) 400. *Valves*, Eddy, Ludlow. *Pressure-recording gauge*, Edson.

Consumption, 12,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, about $1,000,000. Debt, $425,000. Int., 6%. Ann. op. exp., $70,000. Ann. rev.: consumers, not given, but est., $150,000.

Management.—Dept. Pub. Works. Prest., Elmer Washburn. Supt., Jas. A. Duggan. Address at Union Stock Yards.

URBANA, *Champaign Co.* See Champaign.

VENICE, *Madison Co.* (Pop., 612; est., 800.) On Mississippi river.

History.—Built in '86 by village, for fire protection, mains being connected with a private line.

In '88 an independent system was completed, and put in operation Jan. 1, '89. Engr., Lucas Pfifenberger. Contrs. for masonry, Niemes & Reiman, East St Louis; for buildings, Cheeseman & Co., St. Louis, Mo.

Water Supply.—Mississippi river, pumping to tank.

Pumping Machinery.—Two Deane pumps, dy. cap., 500,000 galls.

Tank.—Is 15 by 22 ft. Contrs., Cheeseman & Co., St. Louis, Mo.

Distribution.—*Mains*, 6-in., 1½ miles; furnished by Clarkson & Co., St. Louis, Mo. *Taps*, 9.

Consumption, 1,000 galls.

Financial.—Cost, $10,000. Bonded debt, $7,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,000.

Management.—Trustees. Clerk, C. S. Youree.

WASHINGTON, *Tazewell Co.* (Pop., 1,397; est., 1,500.) Engaged in manufacturing.

History.—Built in '88 by village. Engr. and Contr., Geo. C. Morgan, Chicago

Water Supply.—Driven wells, pumping to stand-pipe.

Pumping Machinery.—Deane duplex, dy. cap., not given.

Tank.—Cap., 21,000 galls.; 11 ft. in diam. and 36 ft. high.

Distribution.—*Mains*, wood, 2¾ miles. *Services*, iron.

Pressure: Ordinary, 40 lbs.

Financial.—Cost, $15,000. Bonded debt, $15,000. Int., 6%.

Management.—Not given. Report by Chas. Koker. Village Clerk, J. H. Colvin.

WAUKEGAN, *Lake Co.* (Pop., 4,021; est., 5,000.) On a bluff 80 ft. above and overlooking Lake Michigen, 36 miles north of Chicago. Has various manufactories. Settled in '34: incorp. a city in '59.

History.—Built in '74 by town. Labor done by the day.

Water Supply.—Three flowing artesian wells, by gravity. The first well is 1,134 ft. deep, and water rises from it 65 ft. above the surface. Rock was encountered in the first well at a depth of 180 ft., to which point a 4-in. pipe was inserted. This pipe corroded and was replaced in '81. The first well discharged into a small brick reservoir, 20 ft. sq. and deep, built half above the ground.

Distribution.—*Mains*, c. i., wood, about 4 miles. *Services*, not given. Pipe and specials furnished by Cincinnati & Newport Iron & Pipe Co., Newport, Ky., and Addyston (O.) Pipe Works. *Taps*, about 200. *Meters*, none. *Hydrants*, kind not given, (in '88,), 25.

Consumption, not given. *Pressure*: Ordinary, 16 lbs.

Financial.—Cost, about $20,000. No debt. Ann. op. exp., $800. Ann. rev.: consumers, $800.

Management.—Town Clerk, A. B. Palmer.

YORKVILLE, *Kendall Co.* (Pop., 365; est., 1,150.) On Fox river. Engaged in manufacturing and trade.

History.—Built in '87 by village. Engr., Geo. C. Morgan, Chicago.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 300,000 galls.

Distribution.—*Mains*, Wyckoff wood, 2 miles.

Pressure: Ordinary, 85 lbs.

Management.—Com. of three. Prest., P. Framm.

Water-Works Projected with Fair Prospects of Construcion.

BUSHNELL, *McDonough Co.* (Pop., 2,316; est., same.) On prairie. Engaged in manufacturing.

Proposed System.—The village voted $10,000 for water-works in '88, and in June were sinking a test well. If water was found it would be pumped to a stand-pipe. Further data cannot be obtained. City Clerk, O. C. Hicks.

CARLINVILLE, *Macoupin Co.* (Pop., 3,117; est., 4,500.)
Proposed System.—A private company to build works in '89, pumping from a creek having a drainage area of 80 sq. m. to a steel stand-pipe, 10 ft. in diam. and and 115 ft. high; direct pressure also to be used. To have two 750,000-gall. compound pumps. To have about five miles of 10 to 4-in. cast-iron mains, and 52 hydrants on four miles of pipe. The company was not fully organized Dec. 19, '88, but a 30 years' franchise had been granted, and a contract made for 52 hydrants for $3,000, and $50 for additional. Provision is made for the city to buy the works at the end of 15 years, or at the end of any 5 years thereafter. F. W. Raeder, St. Louis, Mo., is Engr. City Clerk, W. H. Behrens.

JERSEYVILLE, *Jersey Co.* (Pop., 2,894; est., 4,000.) Has various manufactories.
Proposed System.—Geo. C. Morgan, Chicago, has contract for works. An artesian well was sunk 2,000 ft. in '87-8, by the village, with J. P. Miller, Chicago, as Contr., but the water is not satisfactory in quantity or quality. If water is found works will be built in '89. Address J. S. Daniels, Jerseyville, or Geo. C. Morgan, 16 Major Block, Chicago.

MURPHYSBORO, *Jackson Co.* (Pop., 2,196; est., 5,000.) On Big Muddy river. Has coal mines.
Proposed System.—Gray Bros., Milwaukee, Wis., sunk a well for the village in '88, and $5,000 was expended for water-works. The supply of water is insufficient except in wet weather. It is not stated whether the works will be completed. City Clerk, Fred Brauer.

NORWOOD PARK, *Cook Co.* (Pop., of township, 1,675; village, est., 1,500.) About 10 miles west of Chicago.
Proposed System.—The village has let contract for water-works to Geo. C. Morgan, Chicago, to be completed by July 1, '89. An artesian well has already been sunk, from which water will flow to a reservoir, and be pumped thence by a 500,000-gall. high-pressure pump to a Morgan's special tower. There will be about 2½ miles of wooden pipe.

STAUNTON, *Macoupin Co.* (Pop., 1,358; est., 2,400.)
Proposed System.—C. A. Tuttle & Son, Decatur, put in a dam for a reservoir in '88, at a cost of $12,200. There is a debt of $6,000 on this at 7% int. A complete system will be constructed as soon as arrangements are made for more money. The reservoir has a cap. of 99,000,000 galls., and covers 20 acres. Engr., Lewis Slockett, St. Louis, Mo. Town Prest., J. C. Parkhurst.

SULLIVAN, *Moultrie Co.* (Pop., 1,305; est., 1,500.)
Proposed System.—The town has a well 6 ft. sq. and 73 ft. deep, from which it is proposed to raise water by a windmill pump to a 51,000-gall. tank. Address Jas. Dedman, or Ed. Hall, Town Clerk.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Bunker Hill, *Macoupin Co.*; Calumet, *Cook Co.*; Centralia, *Marion Co.*; Coal City, *Grundy Co.*; Collinsville, *Madison Co.*; Creston, *Ogle Co.*; Duquoin, *Perry Co.*; Gridley, *McLean Co.*; Ipava, *Fulton Co.*; Loda, *Iroquois Co.*; Macomb, *McDonough Co.*; Marshall, *Clark Co.*; Mt. Vernon, *Jefferson Co.*; Monticello, *Platt Co.*; Morristown, *Henry Co.*; Olney, *Richland Co.*; Pana, *Christian Co.*; Trenton, *Clinton Co.*; Tuscola, *Douglas Co.*; Vandalia, *Fayette Co.*

WISCONSIN.

Water-Works Completed or in Process of Construction.

APPLETON, *Outagamie Co.* (Pop., 8,005; est., 11,000.) On both sides of Fox river, which falls 40 ft. within the city limits. The river here flows through a valley ½ mile wide and 50 to 65 ft. deep, with deep sides intersected by gullies. Has various manufactories.

History.—Built in '82 by Wiley Construction Co., under a 20 years' franchise. At the end of this time provision is made for the purchase of the works by the city. Des. Engr., E. C. Cooke, Tiffin, O.

Water Supply.—Fox river and three 6 in. artesian wells, by direct pumping. The first well is 430 ft. deep, and extends into the Potsdam sandstone. Water from it contains sand, and is allowed to settle before being used. The second well was sunk in '84, and the third, later. The flow of the wells is decreasing.

Settling Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 4,000,600 galls.; three Deane pumps, two being 12 in. in diam. and of 24-in. stroke, driven by water-power, and having a cap. of 3,000,000 galls. Victor turbine water wheels are used, water for driving them being taken from the pool formed by a stone dam 700 ft. long, built by the U. S. Government. The third is a direct-acting steam pump of 1,000,000 galls. cap., with 24-in. steam and 12-in. water cylinder of 24-in. stroke.

Distribution.—*Mains*, c. i., 16 miles. *Services*, galv. i. *Taps*, (in '86,) 800. *Meters*, "only a few." *Hydrants*, Mathews, 101. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 71 lbs. Fire, 115 lbs.

Financial.—Capital stock, in '84, $100,000. Hydrant rental, $75 for first 80, and $70 for additional. All over 90 hydrants on original mains, free.

Management.—Prest., S. L. Wiley, Omaha. Supt., Jno. Hayes.

ASHLAND, *Ashland Co.* (Pop., 951; est., 6,000.) On Lake Superior. Engaged in iron mining and lumber industries.

History.—Built in '84-5 by Ashland Water Co., under a 50 years' franchise. Des. Engr., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Chequamegon bay, Lake Superior, by direct pumping.

Intake Pipe.—Is 16-in. in diam. and extends into the bay about 2,100 ft.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound condensing Holly-Gaskill pumps, and two horizontal tubular boilers.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i., lead. *Taps*, 435. *Meters*, 10. *Hydrants*, Holly and Holly-Gaskill, 72.

Consumption, 600,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 140 lbs.

Financial.—Cost, $165,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $14,000; city, $6,480. Hydrant rental, $100 for 54, and $60 for 18.

Management.—Prest., T. T. Flagler. V. Prest., P. H. Linneen. Treas., H. H. Flagler. Secy., Wm. Reinecke. Supt., W. C. Pooley.

BARABOO, *Sauk Co.* (Pop., 3,266; est., 5,000.) On Baraboo river, which affords water-power.

History.—Built in '86-7 by Moffett, Hodgkins & Clarke, Watertown, N. Y. who were the Engrs. and Contrs. The local name is the Baraboo Water-Works Co. The franchise is for 30 years. E. G. Ferris was Res. Const. Engr. Contr. for masonry, Reuben Wilby; for buildings, Geo. Capenor.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane duplex water-power pump of 11-in. bore and 12-in. stroke.

Stand-Pipe.—Is 30 ft. in diam. and 52 ft. high, with its bottom 130 ft. above the town, and its top 250 ft. above the pump. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and laid by the city. *Taps*, 184. *Meters*, 1. *Hydrants*, Holly, Ludlow, 81. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 150 lbs.

Financial.—Cost, $130,000. Debt, $100,000. Int., 6%. Ann. op. exp., withheld, but est., $1,500. Ann. rev.: consumers, withheld, but est., $5,000; city, $3,300. Hydrant rental, $41.25.

Management.—Prest., J. F. Moffett. Secy., Chas. T. Moffett. Both of Watertown, N. Y. Supt., J. W. Reade.

BAYFIELD, *Bayfield Co.* (Pop., 564; est., 2,500.) On Bayfield Harbor, Lake Superior. Engaged in fishing, quarrying and lumbering.

History.—Built in '86 by Bayfield Hydraulic Co. Des. Engr., E. F. Glover. Const. Engr., R. D. Pike.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 150,000 galls.

Distribution.—*Mains*, iron, 2½ miles. *Services*, iron. *Taps*, 60. *Meters*, none. *Hydrants*, Holly, 12.

Consumption, not given. *Pressure*: 50 lbs.

Financial.—Cost, $20,000. Capital stock and bonds, $50,000. Ann. op. exp., withheld, but est., $500. Ann. rev., consumers, $1,200; city, $1,000. Hydrant rental, about $80.

Management.—Supt., A. Tate. Report by F. W. Dennison.

BEAVER DAM, *Dodge Co.* (Pop., 3,416; est., 4,500.)

History.—Built in '88 by Moffett, Hodgkins & Clark, Watertown, N. Y., with E. G. Ferris as Const. Engr.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery and Stand-Pipe, not described.

Distribution.—*Mains*, 8 miles. *Hydrants*, 78.

Financial.—Hydrant rental, $3,000, or about $40 each.

Management.—Address Moffett, Hodgkins & Clarke, Watertown, N.Y.

NOTE:—Other data not determined or withheld.

BELOIT, *Rock Co.* (Pop., 4,790; est., 6,500.) On Rock river, which furnishes water-power for manufacturing purposes.

History.—Built in '85 by Beloit Water-Works Co. Des. Engr., M. M. Moore, of Fairbanks, Morse & Co., Chicago, Ill., the Contrs. Const. Engr., J. R. Kinley, Chicago, Ill.

Water Supply.—Well, 30 ft. in diam. and 40 ft. deep, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Smith & Vaile compound duplex 1,000,000-gall. pumps, and two steel boilers.

Tank.—Cap., 100,000 galls.; on stone tower, 85 ft. high. Contrs., Eclipse Wind Engine Co., Beloit.

Distribution.—*Mains*, c. i., 8 miles. *Services*, iron, lead. Pipe laid by C. E. Gray, Chicago, Ill. *Taps*, 400. *Meters*, 20. *Hydrants*, Mathews, 75. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, $100,000. Capital stock, $50,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,750. Ann. rev.: consumers, $5,500; city, $5,000. Hydrant rental, $75.

Management.—Prest., J. B. Peet. V. Prest., C. H. Morse. Secy. and Treas., C. B. Salmon. Supt., H. Wheeler. Report by City Clerk, E. F. Hansen.

BLACK RIVER FALLS, *Jackson Co.* (Pop., 1,427; est., 3,500.) On Black river. Engaged in manufacturing.

History.—Built in '86-7 by town. Engrs., Loweth & Curtis, St. Paul, Minn. Contrs. for masonry, brick buildings and stand-pipe, Price Mfg. Co.; for other labor and material, Philip Buehner, St. Paul, Minn.

Water Supply.—Creek, filtered, pumping to stand-pipe.

Filter.—Not described.

Pumping Machinery.—Dy. cap., 1,000,000 galls ; Gordon & Maxwell duplex pump and steel tubular boilers.

Stand-Pipe.—Is 16 ft. in diam. and 100 ft. high; contract sublet to Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 70. *Meters*, 1. *Hydrants*, Galvin, 15. *Valves*, Galvin

Consumption, 40,000 galls. *Pressure*: 100 lbs.

Financial.—Cost, $25,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $2,000. Ann. rev.: consumers, $900; city, $100.

Management.—Supts., E. G. Greenlee and B. R. Falls.

CHIPPEWA FALLS, *Chippewa Co.* (Pop., 3,982; est., 13,000.) On Chippewa river, which furnishes water power.

History.—Built in '85 by Moffett, Hodgkins & Clarke, Watertown, N. Y.

Water Supply.—Chippewa river, filtered, pumping to tank.

Filter, Pumping Machinery and Tank, not described.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. *Taps* and *Meters*, withheld. *Hydrants*, kind not given, 100.

Consumption and *Pressure*, not determined.

Financial.—Cost, $150,000. Debt, $130,000. Int., 6%. Ann. op. exp., withheld, but est., $5,000. Ann. rev.: consumers, withheld, but est., $10,000; city, $5,500.

Management.—Prest., H. W. Phelps, Minneapolis, Minn. Secy., L. M. Newman. Supt., H. B. Shamp. Pumping Engr., C. Buntz.

DARLINGTON, *La Fayette Co.* (Pop., 1,372; est., 2,000.) On Pecatonica river. Engaged in manufacturing and trade.

History.—Built in '86-7 by town. Engr., G. A. Marshall, Darlington. Contrs., Eclipse Wind Engine Co., Beloit, Wis.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 60,000 galls.; Smedley pumps.

Reservoir.—Cap., about 100,000 galls.; 15 by 100 ft., by 10 ft. deep.

Distribution.—*Mains*, c. i., 3 miles. *Services*, Kalamein i. *Taps*, 100. *Meters*, 3. *Hydrants*, kind not given, 16.

Consumption, 10,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 to 100 lbs.

Financial.—Cost, $15,000. Bonded debt, $15,000. Int., 5%. Ann. op. exp., $300. Ann. rev.: consumers, $700.

Management.—City Engr., J. H. Martin. Supt., H. C. Martin.

DE PERE, *Brown Co.* (Pop., 817; est., 2,500.) On Fox river. Manufactures pig iron, freight cars, agricultural implements and drain tiles.

History.—Built in '86 by Artesian Water Supply Co., under a 25 years' franchise. Engrs., Michigan Pipe Co., Bay City, Mich.

Water Supply.—Flowing artesian well with a daily yield of 2,000,000 galls., by gravity.

Distribution.—*Mains*, Wyckoff wood, 4 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Gaskill, 23.

Consumption, unknown. *Pressure*: 43 lbs.

Financial.—Cost, $12,500. Capital stock, $25,000. No debt. Ann. op. exp., $250. Ann. rev.: consumers, $865; city, $535.

Management.—Prest., Wm. Armstrong. Secy., E. F. Parker. No Supt.

EAU CLAIRE, *Eau Claire Co.* (Pop., 13,094; est., 22,000.) At junction of Eau Claire and Chippewa rivers.

History.—Built in '85 by Eau Claire Water-Works Co. Engr., M. M. Moore. Contr. for buildings, F. E. Hinds, Eau Claire.

Water Supply.—Chippewa river, filtered, by direct pumping.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; Smith & Vaile water-power pumps driven by two 48-in. New American turbines, under 19-ft. head.

Filter.—Two 15-ft. Hyatt filters, dy. cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 24 miles. *Services*, w. i., lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by Jas. H. Harlow, Pittsburg, Pa. *Taps*, 452. *Meters*, none. *Hydrants*, Mathews, 305. *Valves*, Eddy.

Consumption, 800,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 90 to 120 lbs.

Financial.—Hydrant rental, $54 for those on original mains, and $44 on extensions. All other data withheld.

Management.—Prest., O. H. Ingram. V. Prest., C. H. Morse. Secy. and Treas., C. A. Sharpe, corner Lake and La Salle St., Chicago, Ill.

FOND DU LAC, *Fond du lac Co.* (Pop., 13,094; est., 17,000.) At south end of Lake Winnebago.

History.—Built in '85 by Fond du Lac Water Co., under a 20 years' franchise. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Four 600-ft. artesian wells, by direct pumping, with storage reservoir for fire protection.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000-gall. compound Holly-Gaskill pumps.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i. *Taps*, 203. *Meters*, 5. *Hydrants*, Gaskill, 145.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Capital stock, $50,000. Bonded debt, $150,000. Int.,

6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $6,000; city, $9,500. Hydrant rental, $64.

Management.—Prest., T. T. Flagler, Lockport, N. Y. V. Prest., C. H. Benton. Secy., Wm. Reinecke, Louisville, Ky.

FORT HOWARD, *Brown Co.* See Green Bay and Fort Howard.

GREEN BAY and FORT HOWARD, *Brown Co.* (Pop., Green Bay, 7,404; est., 12,000. Fort Howard, 3,083; est., 6,000.) Both towns are on Fox river at the head of Green bay. Engaged in lumber industries and manufacturing.

History.—Built in '85-6 by Green Bay & Ft. Howard Water-Works Co., without contractors for labor. A 30 years' hydrant contract with each city.

Water Supply.—Flowing artesian well, by gravity, with a storage reservoir. The well is 921 ft. deep, and its flow gives a pressure of 47 lbs. at the ground surface.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, w. i. and cement, 24 miles. *Services*, galv. and asphalt-coated iron. *Taps*, 700. *Meters*, none. *Hydrants*, Chapman, 261.

Consumption, 150,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $300,000. Capital stock, $300,000. No bonds issued to June, '88. Ann. op. exp., not given, but est., $15,000. Ann. rev.: consumers, withheld, but est., $20,000; city, $9,000. Hydrant rental, about $40 for each hydrant.

Management.—Prest., Eli Marvin. Treas., T. K. Miller. Secy., A. C. Neville. Supt., W. K. Harrington. Pumping Engr., J. H. Marvin.

HAYWARD, *Sawyer Co.* (Pop., est., 1,500.)

History.—Built in '87-8 by private company. Contr. for labor, Theo. Bunker.

Water Supply.—Namakagon river, by direct pumping.

Pumping Machinery.—Knowles pump, dy. cap., 1,250,000 galls.; two 4 by 14-ft. tubular boilers.

Distribution.—*Mains*, c. i., 1⅜ miles. *Services*, w. i. Pipe and specials from Buffalo (N. Y.) Cast-Iron Pipe Co. *Taps*, 18. *Meters*, not given. *Hydrants*, Galvin, 18. *Valves*, Galvin.

Pressure: Ordinary, 35 lbs. Fire, 80 lbs.

Financial.—Cost, $20,000. Debt, not given. Int., 10%.

Management.—Supt., Theo. Bunker.

HUDSON, *St. Croix Co.* (Pop., 665; est., 3,500.)

History.—Built in '87-8 by village. Des. Engr., H. H. Harrison, Stillwater, Minn. Const. Engr., Jas. P. Andrews, Hudson. Contr. for masonry and buildings, P. Kurcher, Hudson.

Water Supply.—Artesian well, pumping to reservoir.

Pumping Machinery—Dy. cap., 1,000,000 galls.; Blake pump and Atlas boilers.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O.; trenching and pipe-laying done by N. N. Johnson & Son, Stillwater, Minn. *Taps*, 47. *Meters*, none. *Hydrants*, Galvin, 40. *Valves*, Galvin.

Pressure: Ordinary, 90 lbs. Fire, 90 to 100 lbs.

Financial.—Cost, $40,000. Bonded debt, $30,000. Int., 4%.

Management.—Supt., C. P. Coon.

HURLEY, *Ashland Co.* (Pop., est., 4,000.) On Montreal river, in iron mining region.

History.—Built in '87 by Gogebic Water & Gas Supply Co. Engr., Geo. E. Price, Hurley.

Water Supply.—Montreal river, pumping to reservoir.

Pumping Machinery.—Worthington pumps, dy. cap., not given.

Reservoir.—Not described.

Distribution.—*Mains*, 3 miles. *Hydrants*, 35.

Financial.—No data given.

Management.—Prest., G. E. Beach. Secy., C. E. Lovell. Supt., J. C. Price. Pumping Engr., J. Patton.

JANESVILLE, *Rock Co.* (Pop., 9,018; est., 12,000.) On Rock river, which furnishes water-power used in manufacturing farming implements, carriages, cotton goods and other articles.

History.—Built in '87-8 by Janesville Water Co., under a 20 years' franchise owned by Turner, Clarke & Rawson, Boston, Mass. Des. Engr., B. R. Clarke. Const. Engr., J. Frank Williams. Contrs., Wiley Const. Co. All of Boston, Mass.

Water Supply.—Flowing artesian well, pumping from receiving reservoir to stand-pipe. The well is 10 in. in diam., cased to 8 in., and is 1,043 ft. deep.

Reservoir.—Cap., 800,000 galls.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two duplex compound condensing 2,000,000-gall. Blake pumps, and three 80 H. P. tubular boilers.

Stand-Pipe.—Cap., about 250,000 galls.; gives head of 185 ft. Contrs., Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i. Pipe furnished by Addyston (O.) Pipe & Steel Co., and the Donaldson Iron Co., Emaus, Pa.; specials from Builder's Iron Foundry, Providence, R. I. Trenching and pipe laying sublet to Carroll E. Gray, Jr., Chicago, Ill. *Taps* and *Meters*, not determined at time of report. *Hydrants*, Coffin, 180. *Valves*, Rensselaer. *Pressure-recording gauge*, Edson.

Consumption, not determined. *Pressure*: Ordinary, 40 to 75 lbs. Fire, 125 lbs.

Financial.—Capital stock, $200,000. Hydrant rental, $4,200 for 180, or about $25 each; $25 for each hydrant on extensions, hydrants 400 ft. apart. No further financial data given.

Management.—Prest., B. R. Clarke. Treas., A. B. Turner. Secy., J. E. Dodge. Supt., T. T. Croft.

KENOSHA, *Kenosha Co.* (Pop., 5,039; est., 7,000.) On Lake Michigan, the bank of which at this point is from 8 to 15 ft. above the water. Ground rises gradually for three miles to a height of 60 ft. Has various manufactories. Settled in '35; incorp. a city in '50.

History.—Built in '78-9 by Park City Water Co., under a 20 years' franchise. Des. Engr., Chas. O' Connor. Labor done by the company.

Water Supply.—Four flowing artesian wells, by gravity. The first well is 4½ in. in diam. and 1,36 ft deep, cased with iron pipe for 185 ft. from the surface. Rock was encountered at 90 ft. below the surface.

Distribution.—*Mains*, 6 to 3 in. c. i., 4 miles. *Services*, lead. Wrought iron pipe used for services was rapidly destroyed by the water. *Taps*, 425. *Meters*, 6. *Hydrants*, Morgan, 33. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure*: Ordinary, 32 lbs. Fire, 45 lbs.

Financial.—Cost, $25,000. Capital stock, $12,000. Bonded debt, $5,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,000; city, $825. Hydrant rental, $25.

Management.—Pres., Lewis Bain. Treas., U. J. Lewis. Secy. and Supt., E. J. Hazleton.

LA CROSSE, *La Crosse Co.* (Pop., 14,505; est., 28,000.) On Mississippi river. The La Crosse and Black rivers flow through the city, emptying into the Mississippi. The central part of the city on both sides the La Crosse is on low land, north of which is a plateau 20 ft., and south of which is another 40 ft. above the river. Engaged in manufacturing and lumber interests. Laid out in '51; incorp. a city in '56.

History.—Built in '77 by city after plans by City Engr. H. I. Bliss. The pumping was done by mill owners until pumping works were built by the city in '80-1. W. M. Robinson has been Engr. for some of the extensions since '77.

Water Supply.—Mississippi river, by direct pumping.

Intake Pipe.—Laid in '80-1; 16-in. c. i., 600 ft. long, of which 173 ft. is submerged and has flexible joints.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; two Blake pumps, and two 18-ft. tubular boilers.

Distribution.—*Mains*, c. i., 16½ miles. *Services*, galv. i. *Taps*, 1,069. *Meters*, 2. *Hydrants*, Mathews, 143. *Valves*, Chapman.

Consumption, 2,197,628 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $169,964. No separate water debt. In '82 it was estimated that about $20,000 of money raised by city bonds had been spent on water-works. Ann. op. exp., $9,977; Ann. rev.: consumers, $13,813; city, none.

Management.—Board of Public works. Prest., J. A. Leinfelder. Secy., S. F. Nice. Supt., T. S. Vicker. Pumping Engr., T. Martin.

MADISON, *Dane Co.* (Pop., 10,324; est., 12,000.) Engaged in manufacturing and trade.

History.—Built in '82 by city. Engr., Chester B. Davis, Chicago, Ill. Contrs. for masonry and buildings, G. E. Libbey & Son, Janesville.

Water Supply.—Artesian wells, by direct pumping. There are nine wells, the last extending 200 ft. to rock, being 6 in. in diam., cased.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two non-condensing Reynolds-Corliss engines and Knowles pumps; Jarvis boilers. The average cost, in '87, of coal used in raising 1,000,000 galls. 1 ft. was $0.0598. Pumping machinery furnished by Hoffman Billings Mfg. Co., Milwaukee, Wis.

Distribution.—*Mains*, c. i., 21 miles. *Services*, lead. Pipe and specials furnished, originally, by Cincinnati & Newport Iron Co., Newport, Ky., and for extensions by Dennis Long & Co., Louisville, Ky. Trenching and pipe-laying done by M. Philbin & Co., Chicago. *Taps*, 980. *Meters*, 7. The meter system was adopted in '87, and meters are to be placed on all new services, and upon all old services rating above $12.50, and in time upon every service. *Hydrants*, Mathews, 118. *Valves*, Ludlow.

Consumption, 715,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 160 lbs.

Financial.—Cost, $173,102. Bonded debt, $76,000. Int., 5%. Ann. op. exp., $8,740. Ann. rev.: consumers, $13,480; city, none.

Management.—Five Commrs. Prest., Jas Conklin. Secy., Jno. Corscot. Supt., Jno. B. Heim.

MANITOWOC, *Manitowoc Co.* (Pop., 1,281; est., 8,000.) On Lake Michigan at mouth of Manitowoc river. Engaged in boat-building, trade and manufacturing.

History.—Built in '88 by Moffett, Hodgkins & Clarke, Watertown, N. Y., under a 20 years' franchise. Const. Engr., E. G. Ferriss.

Water Supply.—Lake Michigan, through filter galleries, pumping to stand-pipe.

Filter Galleries.—Not described.

Pumping Machinery.—Two 1,500,000-gall. pumps.

Stand-Pipe.—Not described.

Distribution.—*Mains*, 13 miles. *Hydrants*, 132.

Financial.—Not given.

Management.—Address above company.

MARINETTE, *Marinette Co.* (Pop., 5,412; est., 12,500.) On Green bay, Lake Michigan, at the mouth of the Menominee river. Manufactures lumber, machinery and paper.

History.—Built in '88 by the American Water-Works and Guarantee Co., Ltd., Pittsburgh, Pa., under a 20 years franchise. Known locally as the City Water-Works Co. The city has the right to buy the works 10 years after date of acceptance. Des. Engr., H. J. Hilbert, Milwaukee. Const. Engr., J. H. Purdy, with E. C. Barstow as Res. Asst. Engr. Contr. for masonry, building and pipe-laying, A. W. Stevens, Logansport, Ind.; M. Walker, Fenton, Mich., was associated with the latter in laying submerged pipe.

Water Supply.—Green bay, by direct pumping.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; Deane pumps.

Distribution.—*Mains*, 14½ miles. *Taps*, about 400. *Hydrants*, Ludlow, 125. *Valves*, Ludlow.

Financial.—Cost, est., $155,000. Capital stock, $200,000. Bonded debt, $125,000. Int., 6%. Hydrant rental, $46 for 125, and $30 for each additional.

Management.—Supt., C, D. Barstow.

MARSHFIELD, *Wood Co.* (Pop., 1,001; est., 3,300.)

General Description.—A fire protection system has been established, and consists of 4-in. pipes laid through the main streets, and extending through the premises of the Upham Mfg. Co., who own the pumps and receive a rental from the town for fire protection. Supt., J. D. Wattles.

MAZO MANIE, *Dane Co.* (Pop., 1,646; est., 1,200.) Has manufactories.

History.—Built in '88 by village.

Water Supply.—Millpond of Mazo Manie mill, by direct pumping.

Pumping Machinery.—Gould & Austin rotary pump, operated by owners of mill.

Distribution.—*Mains*, 4-in. w. i., 1,200 ft. *Taps*, 2. *Hydrants*, 4.

Financial.—Cost, $1,200. No debt. Ann. op. exp., $25. No rev.

Management.—Supt., S. E. Bronson.

MENOMINEE, *Dunn Co.* (Pop., 2,589; est., 7,000.) On Red Cedar river.

History.—Built in '84-5 by Moffett, Hodgkins & Clarke, Watertown, N. Y., with E. G. Ferriss as Res. Engr. The franchise is for 30 years.

Water Supply.—Springs and Red Cedar river, pumping to stand-pipe and direct.

Pumping Machinery.—Dp. cap., 1,000,000 galls.; two duplex compound condensing Gordon & Maxwell pump, and 5 by 16-ft. boilers.

Stand-Pipe.—Cap., 88,000 galls.; 15 by 80 ft. Contrs., Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, c. i., 10.6 miles. *Services*, galv. i, Pipe and specials furnished by Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and trenching and pipe-laying done by C. E. Gray, Jr., Chicago, Ill. *Taps*, 161. *Meters*, none. *Hydrants*, Pattee & Draper, 106.

Consumption, 100,000 galls. *Pressure*: Ordinary, 93 lbs. Fire, 150 lbs.

Financial.—Cost, $125,000. Debt, $90,000. Int., 6%. Ann. op. exp., withheld, but est., $2,500. Ann. rev.: consumers, withheld, but est., $6,000; city, $4,150. Hydrant rental, $50.

Management.—Supt., E. H. Weber.

MERRILL, *Lincoln Co.* (Pop., est., 6,000.) On Wisconsin river. Manufactures lumber.

History.—Built in '87 by City Water-Works Co., and managed by American Water Works & Guarantee Co., Ltd., Pittsburg, Pa. Franchise is for 30 years. The city has the privilege of buying the works at the end of 10 years or at the end of any 5 succeeding years.

Water Supply.—Prairie river, pumping to stand-pipe,

Pumping Machinery.—Two Deane pumps, dy. cap., 4,000,000 galls.

Distribution.—*Mains*, 12 to 5-in. iron, 9½ miles. *Services*, not given. Pipe and specials from the National Tube Works, Chicago, Ill. *Taps* and *Meters*, withheld. *Hydrants*, Ludlow, 101. *Valves*, Ludlow.

Consumption and *Pressure*, not given.

Financial.—Cost, $98,000. Capital stock, $125,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp. and rev., not determined. Hydrant rental, $45.

Management.—Prest., S. M. Highlands. Secy. and Treas., W. S. Kuhn, Pittsburgh, Pa. Supt., C. A. Taylor.

MILWAUKEE, *Milwaukee Co.* (Pop., 115,587; est., 185,000.) On Milwaukee bay and river, on Lake Michigan. Two small rivers join the Milwaukee about a mile from its mouth. The banks of the lakes and rivers rise quite abruptly in some places, and in gentle slopes in others, to an elevation of 150 ft. on the west, and 75 ft. on the east of the river. The city has an area of about 17 sq. m. and about 200 miles of streets. Founded in '35.

History.—Built in '72-3 by city when population was about 75,000. Engr., Moses Lane. A temporary supply was used for about a year, having been discontinued in '74.

Water Supply.—Lake Michigan, pumping to stand-pipe and reservoir, with re-pumping to stand-pipe for high service.

Intake Crib.—At ordinary low water the depth of the lake at the crib is 18 ft. The crib is hexagonal, the length of the outer side being 21 ft., and of the inner, 8 ft. Each wall is formed by two rows of piles driven close, with the 6 ft. of space between the walls filled with stone. The top of the crib is 7 ft. above the lake surface, and the piles are decked with heavy timber. Gates in the crib allow water to be drawn at any point from 4 to 12 ft. below the surface. The openings are protected by copper wire screens.

Intake-Pipe.—The first pipe was of 36-in. cast-iron, with ball and socket joints. It extends 2,100 ft. into the lake, 2½ miles from the mouth of the river. Piles are driven each side of the pipe, and deck, forming a bridge from the shore to the crib.

Pump-Well.—Is 10 ft. wide and 28 ft. long, divided by cross walls. The bottom of the well is 20 in. of masonry laid upon 4 in. oak plank spiked to 12-in. oak timbers. The walls of the well are 5 ft. thick. The well bottom is 11 ft. below extreme low, and 16 ft. below extreme high water.

Pumping Machinery.—Dy. cap., 28,000,000 galls.; Allis pumps, and return flue and tubular boilers. In '87 a new high service pumping station was established, to supersede the one erected in '78, and a 6,000,000-gall. Allis pump put in. An old 3,-

000,000-gall. pump was transferred from the old high service station,and will be used as an auxiliary. The first two pumps at the main station have compound condensing beam engines, coupled to one fly-wheel, arranged to work together or separately. The pumps were of the bucket and plunger pattern, 40 in. in diam. and of 84-in. stroke, with 28-in. plungers.

Stand-Pipe.—Is 4 ft. in diam. and 130 ft high, with its top 210 ft. above the lake. It is enclosed in a stone masonry tower 24 ft. sq. at the base and 175 ft. high. The main shaft is circular, and contains a winding stair-case. The force main to the stand-pipe is of 36-in. cast-iron, 525 ft. long. A 30-in. main, 5,700 ft. long, leads from the stand-pipe to the reservoir, crossing the Milwaukee river on a bridge.

River Crossings.—The force main crosses on a bridge of wrought iron, with four spans, the total length being 580 ft. The bridge has a 17-ft. roadway for traffic. The conduit across the bridge is of wrought iron, carried below the roadway on iron girders. It is protected from the frost by a wooden box. Expansion joints are provided at each end. The Milwaukee river is also crossed by 20 and 16-in. submerged mains, and the Menominee by a 20-in., all having flexible joints.

Reservoir.—Cap., 21,500,000 galls.; in excavation and embankment, covering four acres, and having its high water level 150 ft. above the lake. The banks were built up in 9-in layers, rolled. They are 16 ft. wide on top, with inner slopes of 1½ to 1, and outer of 1¾ to 1. The inner slopes and bottom are covered with 2 ft. of clay puddle. On the inner slopes is a 9-in. layer of broken stone, and upon this a 15-in. stone pavement in cement mortar. The bottom has concrete upon the puddle, and the outer slopes are sodded. A main laid across the reservoir connects the influent and effluent pipes, so that the city can be supplied directly from the stand-pipe.

High Service Stand-Pipe.—Is 15 ft. in diam. and 160 ft. high.

Distribution.—*Mains*, c. i., 148 miles. *Services*, lead. *Taps*, 14,072. *Meters*, 1,728. *Hydrants*, Whittier, 1,298. *Valves*, Whittier. *Pressure-recording gauge*, Edson.

Consumption, 20,089,014 galls. *Pressure*: 38 lbs.

Financial.—Cost, $3,012,877. Debt, $1,709,000. Int., 4 to 7 %. Ann. op. exp., $119,176. Ann. rev.: consumers, $286,052; city, none. An ordinance providing for an allowance by the city of $20 a hydrant has been passed, but it has never been allowed.

Management.—Board of Public Works. Prest. Ex-officio and city Engr., Geo. H. Beuzenberg. Secy., Geo. P. Traenmer.

NEILLSVILLE, *Clark Co.* (Pop., 1,050; est., 2,500.) On Black river. Engaged in lumber industries and manufacturing.

History.—Built in '85 by village. An extension of the system has been proposed. It is now principally for fire protection, no charge being made to consumers.

Water Supply.—Creek, by direct pumping.

Pumping Machinery.—A 500,000-gall. Worthington pump, and an Erie steel boiler.

Distribution.—*Mains*, c. i., 0.2 miles. *Taps*, 4. *Hydrants*, Holly, 4.

Consumption, 3,000 galls. *Pressure*: 90 lbs.

Financial.—Cost, not given. Debt, $2,000. Int., 6%. Ann. op. exp., $1,038. No revenue.

Management.—Supt., R. F. Kountz.

OCONTO, *Oconto Co.* (Pop., 4,171; est., 5,000.) On Green bay at the mouth of Oconto river. Engaged in lumber industries and manufacturing. Settled in '55; incorp. a city in '68.

History.—Built in '83 by Oconto Water-Works Co. Des. Engr., P. W. Preeze.

Water Supply.—Oconto river, pumping to tank.

Pumping Machinery.—Deane pump with 7½ in. steam, and 5-in. water cylinder of 10-in. stroke; cap. not given.

Tank.—Cap., 32,000 galls.; 50 ft. above village.

Distribution.—*Mains*, Wyckoff wood, 1.4 miles. *Services*, w. i. *Taps*, 20. *Meters*, none. *Hydrants*, Holly, 6.

Pressure: 27 lbs.

Financial.—Cost, $4,000. Capital stock, $10,000. No debt. Ann. op. exp., reported as but $30. Ann. rev.: consumers, withheld, but est., $500; city, none.

Management.—Prest., A. Cole. V. Prest. and Supt., Chas. Hall. Secy. and Treas., W. K. Smith.

OSHKOSH, *Winnebago Co.* (Pop., 15,748; est., 25,000.) On Lake Winnebago at the mouth of Fox river, on a nearly level prairie, the ground not rising at any point more than 20 ft. above the lake. Has extensive lumber industries. Settled in '43; incorp. a city in '55.

History.—Built in '84 by Oshkosh Water Co., under a 30 years' franchise. Des. Engrs., MacRitchie & Nichol, Chicago Ill. Const. Engrs. and Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Lake Winnebago and artesian wells, by direct pumping. The supply at first was from three wells, 2, 5 and 3 in. in diam., and 500, 300 and 150 ft. deep, respectively. These discharged into a receiving reservoir, water being found at rock, 105 ft. below the surface, and rising 100 ft. above the surface. The lake has since been drawn upon.

Reservoir.—Is 75 by 150 ft., by 17 ft. deep, and 4 ft. above the lake level; excavated in clay, and paved with dry stone.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; two compound duplex Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 24 miles. *Services*, lead. *Taps*, 500. *Meters*, 5. *Hydrants*, Holly, 234. *Valves*, Ludlow.

Consumption, 1,100,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 1 5 lbs.

Financial.—Cost, $300,000. Capital stock, $200,000. Bonded debt, $260,000. Int., 6%. Ann. op. exp., $7,500. Ann. rev.: consumers, withheld, but est., $25,000; city, $16,040. Hydrant rental, $70 each for 200, and $60 for each additional.

Management.—Prest., D. L. E. Sibby. Secy., G. W. Burnell. Supt., F. B. Barnes.

PORTAGE, *Columbia Co.* (Pop., 4,346; est., 6,000.) Engaged in manufacturing and trade.

History.—Built in '87 by Portage City Water Co., which is controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y. Engr., E. G. Ferriss. Sub-contr. for buildings, Peter Mills. The labor on masonry, trenching and pipe-laying was done by the day, under the company's engineer. The franchise runs for 20 years.

Water Supply.—Wisconsin river, pumping to stand-pipe and direct.

Intake.—Water is brought to the pump through a double wooden flume, the supply being taken 1½ miles above the city and first passing for 50 ft. through a filter of broken stone and gravel. Each division of the flume has a gate, and contains a sponge filter. A 14-in. intake pipe runs out into the stream from the bottom of the filter. To prevent obstruction by sand the intake pipe is placed on oak piles only 2 in. thick driven edgewise to the current, so that the water sweeps under the bottom of the pipe. The outer end of the pipe is turned down-stream, and the blow-off from the force main is connected with the intake, so the stand-pipe can be discharged through the latter.

Pumping Machinery.—Worthington pump, dy. cap., 2,000,000 galls.

Force Mains.—Are 14 and 10-in. in diam., leading to stand-pipe.

Stand-Pipe.—Cap., 76,000 galls.; 25 ft. in diam, and 80 ft. high, at an elevation of of 70 ft., the top being 150 ft. above the town. Of steel plates, 9-16 to ⅜ in. thick. Contrs., Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. Pipe and specials furnished by Warren Foundry & Machine Co., Phillipsburg, N. J., and Lake Shore Foundry, Cleveland, O. *Taps*, 150. *Meters*, 9. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption and *Pressure*, withheld.

Financial.—Cost, $125,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp. and rev. from consumers, withheld. Hydrant rental, $3,000, or $40 each.

Management.—Prest., E. G. Ferriss. Secy., C. F. Moffett. Supt., Jas. W. Reade.

PRAIRIE DU CHIEN, *Crawford Co.* (Pop., 2,777; est., 3,400.) On Mississippi river on slightly rolling prairie about one mile wide, extending back to high bluffs. Has manufactories. Settled in 1776; incorp. a city in '78.

History.—Built in '75-6 by Prairie du Chien Artesian Water Co. Des. Engr., Ira P. Brunson.

Water Supply.—Flowing artesian well, by gravity. The well is 6-in. in diam. and 975 ft. deep. The first 150 ft. is through sand and was cased with iron. This rusted out and was replaced with copper. The rest of the well is through rock. The water is strongly mineral and saline and is but little used for domestic purposes. It discharges at the surface with a head equal to 50 ft.

Distribution.—*Mains*, c. i., 1 mile. *Services*, lead. *Taps*, 18. *Meters*, none. *Hydrants*, Ludlow, 10.

Consumption, unknown. *Pressure*: about 25 lbs.

Financial.—Cost, $8,000. Capital stock, $4,200. No debt. Ann. op. exp., $100. Ann. rev.: consumers, $200; city, $300. Hydrant rental, $30.

Management.—Prest., M. Menges. Secy., Wm. Newton.

RACINE, *Racine Co.* (Pop., 16,031; est., 20,000.) On Lake Michigan at the mouth of Root river, on a plateau about 40 ft. above the lake. Has extensive manufactories and lake commerce. Settled in '35; incorp. a city in '48.

SUPPLY PRIOR TO '87.

General Description.—About '70 the Artesian Well Co. sunk a well 1,300 ft. deep from which water was furnished to one ward of the city. In '78 the city bored a well. The yield of each well in '81 was about 550,000 galls.,and at that time there were 200 taps and 4 hydrants. It is not stated whether the Artesian Well Co. is still in existence.

THE RACINE WATER CO.'S WORKS.

History.—Built in '86-7 under a 25 years' franchise. Des. Engr., A. H. Howland. Const. Engr., Geo. A. Ellis. Contrs., Wiley Const. Co. All of Boston, Mass.

Water Supply.—Lake Michigan, pumping to stand-pipe.

The stand-pipe proper was furnished by Tippett & Wood, Philipsburg, N. J.

Intake Pipe.—Of 24-in. cast-iron, about 1½ miles long, extending 1¼ miles into the lake to 40 ft. of water. The pipe has bell and spigot joints, and was usually lowered to place in sections of six lengths, or 72 ft. These were put together on a dock, towed by scows to the place where they were to be sunk, and lowered to place. The sections were buoyed up by casks. The pipe was laid in a trench dredged 10 ft. below the bed of the lake. Contrs., Thacher & Breymann, Toledo, O.

Pump Well.—Is 14 ft. in diam., carried 14¾ ft. below lowest water, with a 2-ft. concrete floor. A wall with screens divides the well into two equal parts. The intake and suction pipes are within 2 ft. of the floor, supported on an iron framework. A system of valves provides for drawing water directly from the intake pipe, and not through the well, and also for turning the 200 ft. head from the stand-pipe into the intake to free it from anchor ice or other obstructions.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; two duplex pumps, one a compound and the other a high-pressure, and a battery of four 6 by 16-ft. boilers. The chimney is 100 ft. high, with a flue 5 ft. sq.

River Crossings.—Three, of 24, 20 and 8-in. cast-iron pipe; the first two are in a trench 22, and the last in one 18 ft. below the river's surface. These pipes were laid by Thacher & Breymann, as described for the intake.

Stand Pipe.—Cap., about 275,000 galls.; 25 ft. in diam. and 90 ft. high, on a beton foundation and pedestal carried 55 ft. above the original ground surface, or 110 ft. above Lake datum. The foundation is carried 7 ft. below the original ground surface, where it is 37 ft. in diam. The pedestal is 26½ ft. in diam., and consists of an outer solid ring, 4 ft. thick, a hollow space for 4 ft., then a solid 10 ft. in diam. At 19, 37 and 55 ft. above the ground the external ring is connected with the central shaft by semicircular arches and floors.

The material used in construction was one part Saylor's American Portland cement, and one of lake beach sand and gravel. The foundation and pedestal are on a tenacious, clayey hard pan, which sustains an estimated pressure of 3.3 tons per sq. ft.

In the hollow ring in the pedestal is a 10-in. inflow and 16-in. outflow pipe. Each pipe contains a valve, that in the 10-in. pipe being arranged for operation from the pumping station.

Distribution.—*Mains*, c. i., 32 miles. *Services*, galv i. *Taps* and *Meters*, not given. *Hydrants*, Coffin, 314. *Valves*, 314. *Pressure-recording gauge*, Edson.

Consumption, not determined. *Pressure*: Ordinary, 65 lbs. Fire, 120 lbs.

Financial.—Cost, $750,000. Bonded debt, $350,000. Int., 6%. Ann. op. exp., not determined. Ann. rev.: consumers, est., $9,280; city, $13,850. Hydrant rental, $45 each for first 300, and $25 for additional.

Management.—Prest., Henry E. Cott. Treas., A. B. Turner. Both of Boston, Mass. Secy., G. E. Dodge. Supt., Jas. W. Lyon. Pumping Engr., Cyrus Harris.

RHINELANDER, *Oneida Co.* (Pop., est., 2,500.) On Wisconsin river, which furnishes water-power. Engaged in manufacturing and lumbering.

History.—Built in '87 by town, by days labor.

Water Supply.—Wisconsin river by direct pumping.

Pumping Machinery.—Dy. cap., not given; duplex pump furnished by O. L. Packard, Milwaukee.

Distribution.—*Mains*, 8 and 6-in., 1 mile. *Hydrants*, 7.

Financial.—Cost, $8,000. Ann. op. exp., $2,000. Ann. rev.: "nominal."

Management.—Chairman Water Board, W. E. Brown. Pumping Engr., A. M. Cowhen. Report by Jas. W. McCormick.

SHEBOYGAN, *Sheboygan Co.* (Pop., 7,314; est., 18.000.) On Lake Michigan and Sheboygan river. Engaged in lake commerce, lumber industries and various manufactories.

History.—Built in '87 by the City Water Co., controlled by American Water-Works & Guarantee Co., Ltd., Pittsburg, Pa. Des. Engr., Benezette Williams.

Water Supply.—Lake Michigan, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., 5,000,000 galls.

Distribution.—*Mains*, c. i., 18¾ miles. *Services*, galv. i. *Hydrants*, 264. *Pressure*: Ordinary, 55 lbs. Fire, 90 lbs.

Financial.—Cost, $230,000. Capital stock, $250,000. Bonded debt, $200,000. Int., 6%.

Management.—Prest. and Supt., W. D. Cockburn. Secy., W. S. Kuhn, Pittsburg Pa. Treas., S. M. Highlands.

NOTE:—Other data not determined, or withheld.

STEVENS' POINT, *Portage Co.* (Pop., 4,449; est., 10,000.) On Wisconsin river. Has manufactories.

History.—Built in '87-8 by Stevens' Point Water Co. Engr., Jno. Holmes. Contr., Saml. R. Bullock. Both of New York City.

Water Supply.—Wisconsin river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; two compound condensing Holly-Gaskill pumps.

Stand-Pipe.—Cap., 228,000 galls.; 20 ft. in diam. and 120 ft. high. Contrs., Tippett & Wood, Phillipsburg, N. J.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i., lead. Pipe and specials from Florence Iron Works, Philadelphia, Pa. *Hydrants*, Holyoke, 110.

Financial.—Capital stock, $175,000. Bonds, $175,000. Int., 6%. Hydrant rental, $5,000, or about $45.

Management.—Prest., E. Woltmann, 11 Wall St., New York. Treas., J. C. Bertine. Secy., N. P. Hobart. Supt., W. O. Lamorent.

NOTE:—Other data not determined.

STOUGHTON, *Dane Co.* (Pop., 1,353; est., 3,000.) On Catfish river. Manufactures plows and wagons.

History.—Built in '85 by village. Engr. and Contr., Geo. C. Morgan, Chicago Ill.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; one compound and one high-pressure Deane pump.

Tank.—Cap., 30,000 galls.; on a Morgan's special tower, at an elevation of 116 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 3¾ miles.

Financial.—Cost, $30,000. Bonded debt, $30,000. Ann. op. exp., $1,000.

Management.—City Clerk, B. E. Wait.

NOTE:—No further data given.

SUPERIOR and WEST SUPERIOR, *Douglas Co.* (Pop.: Superior, 655; est., 3,000. West Superior, est., 3,000.) At west extremity of Lake Superior.

History.—Built by Superior Water-Works Co. in '87-8. Contrs., R.B.C. Bement & Co., St. Paul, Minn. Headquarters are at W. Superior.

Water Supply.—Superior bay, by direct pumping.

Pumping Machinery.—Compound duplex, dy. cap., not given.

Distribution.—*Mains*, 16 to 4-in. c. i., 9 miles. *Services*, lead. *Taps*, 53. *Meters* not given. *Hydrants*, Mathews, 97. *Valves*, Eddy.

Consumption, not determined. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Capital stock, $100,000. Bonds, $200,000. Hydrant rental, $75 each for first and $60 for second 100; $50 for each additional.

Management.—Prest., R. J. Wemyss. Treas., W. D. Vernam. Secy., F. W. Downes. Supt., Howard Thomas. Pumping Engr., Colon Monroe.

WAUKESHA, *Waukesha Co.* (Pop., 4,613; est., 6,000.) On Fox river, which furnishes water-power. A summer resort.

General Description.—Built in '87 or '88 by Waukesha Water-Works Co. Prest., Eli Marvin. Treas., G. Norman Weaver, Newport, R. I. Secy., S. W. Haight. Supt., J. K. Miller.

The company has been addressed for further information, but makes no response

WAUSAU, *Marathon Co.* (Pop., 4,277; est., 8,500.) On Wisconsin river. Engaged in manufacturing, mining and granite quarrying.

History.—Built in '85 by city. Engr., W. R. Coats, Kalamazoo, Mich. Contr., Holly Mfg. Co., Lockport, N. Y. Sub-contrs.: for masonry, H. Fuming; for buildings, Jno. Miller. Both of Wausau.

Water Supply.—Well, by direct pumping. A suction pipe connects with the Wisconsin river for use in emergency. The well is 30 ft. from the pumping station, 40 ft. in diam. and 37 ft. deep to the bottom of the shoe upon which the caisson is constructed. The bottom of the suction pipe is about 3½ ft. from the bottom of the well, 27 ft. below the pumps and 10 ft. below the water surface.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000-gall. Holly-Gaskill compound pumps, and two 5 by 16-ft. boilers. The chimney is 80 ft. high, and has a flue 3 ft. sq.

Distribution.—*Mains*, c. i., 14¼ miles. *Services*, lead. *Taps*, 414. *Meters*, 4. *Hydrants*, Holly-Gaskill, 109. *Pressure-recording gauge*, Edson.

Consumption, 468,100 galls. *Pressure*: 45 lbs.

Financial.—Cost, $132,126. Bonded debt, $90,000. Int., 5%. Ann. op. exp., $4,100. Ann. rev.: consumers, $6,165; city, none.

Management.—Three Comrs. Supt., Philip Ringle.

WEST DE PERE, *Brown Co.* (Pop., 1,870; est., 2,038.)

History.—Built in '87-8 by West De Pere Artesian Water Supply Co. under a 25 years' franchise.

Water Supply.—Artesian well, by gravity, there being a natural pressure of 43 lbs. Contrs. for well, Gray Bros., Milwaukee, Wis.

Distribution.—*Mains*, Wyckoff wood, 3 miles; furnished and laid by Michigan Pipe Co., Bay City, Mich. *Services*, galv. i. *Taps*, about 100.

Pressure: About 40 lbs.

Financial.—Capital stock, $20,000. No bonds. Debt, $2,200, without int. Hydrant rental, $20 and $25.

Management.—Prest., W. A. Bringham. Supt., J. P. Willard. Report by A. Wilcox.

NOTE:—Other data not given.

Water-Works Projected with Fair Prospects of Construction.

BURLINGTON, *Racine Co.* (Pop., est., 2,000.) On Fox river.

Proposed System.—The village proposes to pump water from a well to a reservoir at a cost of about $15,000. Address Geo. H. Wellin.

UNION GROVE, *Racine Co.* (Pop., est., 600.)

Proposed System.—The village owns an artesian well, and talks of putting in a pump. Est. cost of works, $7,000. Address A. P. Colby.

WASHBURN, *Bayfield Co.* (Pop., est., 4,000.) On Lake Superior. Engage in coal and lumber trade.

Proposed System.—Work to be built in '89 by private company, pumping from Lake Superior to reservoir. Pump to have a dy. cap. of 1,500,000 galls., and reservoir a cap. of 750,000 galls. There will be about 4 miles of mains. The franchise will be for 25 years, with a rental of $75 each for 40 hydrants. Est. cost, $75,000. A contract for the disposal of bonds has been made. Report by D. M. Maxcy & Co.

WHITEWATER, *Walworth Co.* (Pop., 3,617; est., 5,000.)

Proposed System.—Water to be pumped from spring or artesian well to standpipe, probably by a company. City Clerk, H. S. Salisbury.

Water-Works Projects Reported in '87 and '88 but Now Indefinite.

Clinton, *Rock Co.*; Kaukauna, *Outagamie Co.*; New London, *Waupaca Co.*; Ripon, *Fond du Lac Co.*; Tomah, *Monroe Co.*

GROUP 6.—NORTHWESTERN STATES.—Water-Works completed, in process of construction or projected, in Iowa, Minnesota, Kansas, Nebraska, Dakota, Wyoming, and Montana.

IOWA.

Water-Works Completed or in Process of Construction.

ANAMOSA, *Jones Co.* (Pop., 2,083; est., 3,200.) On Wapsipinicon river.

History.—Built in '73-4 by Anamosa Water-Works Co. Engr., J. C. Weir.

Water Supply—Wapsipinicon river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 400,000 galls.; Gordon & Maxwell steam, and a water-power pump.

Reservoir.—Cap., about 90,000 galls.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. *Taps*, 95. *Meters*, none. *Hydrants*, kind not given, 11.

Consumption, 60,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $23,000. Capital stock, $12,000. Bonded debt, $9,000. Int., 8%. Ann. op. exp., $1,000. Ann. rev.: consumers, about $3,000; city, $1,050. Hydrant rental, a five-mill tax is paid on all property within 800 ft. the hydrants.

Management.—Prest., B. Higgins. Secy., W. K. Pearson. Supt., J. C. Griffith.

ATLANTIC, *Cass Co.* (Pop., 3,662; est., 4,000.) On Troublesome creek, on a rolling prairie. Settled in '69; incorp. a city of the second class in '77.

History.—Built in '82-3 by Atlantic City Water Co., but leased and operated by the city. Des. Engr., P. Cowell.

Water Supply.—Cook system of wells, by direct pumping. Water was first taken from an impounding reservoir on the creek, and was filtered.

Pumping Machinery.—Holly pump, dy. cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i. *Taps*, 200. *Meters*, 18. *Hydrants*, Holly, 18.

Consumption, 265,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 68 lbs.

Financial.—Cost, $70,000. Capital stock, $21,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $3,600. Ann. rev.: consumers, $3,200; city, $3,500.

Management.—Supt., W. A. Wilken.

AUDUBON, *Audubon Co.* (Pop., 792; est., 1,500.) On Blue Grass creek on a rolling prairie. Settled in '78; incorp. a city in '80.

History.—Built in '83 by city. Engr., Wm. H. Burnham.

Water Supply.—Well, 16 ft. in diam., pumping to tank.

Pumping Machinery. — Dy. cap., 8,000 galls.; double-acting Smith & Vaile pump of 4-in. diam. and 18-in. stroke, driven by a 25-ft. windmill, built by the U. S. Wind Engine & Pump Co.

Tank.—Is 30 ft. in diam. and 20 ft. high, on a timber trestle 21 ft. high. The tank is 90 ft. above the pump and 65 ft. above the business part of the town.

Distribution.—*Mains*, c. i., 2,500 ft. *Services*, w. i. *Taps*, 17. *Meters*, none. *Hydrants*, Holly, 5.

Consumption, not given. *Pressure*: Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $7,000. Debt, $5,000. Int., 4½%. Ann. op. exp., $40. Ann. rev.: consumers, $200; city, none.

Management.—Supt., E. J. Freeman. Report by V. A. Walkup.

BOONE, *Boone Co.* (Pop., 3,330; est., 7,000.) On elevated rolling prairie two miles west of Des Moines river. Engaged in mining and manufacturing. Settled in '64; incorp. a city in '66.

History.—Built in '84 by city. Des. Engr., T. N. Boutelle. Const. Engr. and Contr., Geo. C. Morgan, Chicago, Ill.

Water Supply.—Artesian well, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Deane pump, and Ferminesch and tubular boilers, of 50 H. P. each.

Tank.—Cap., 22,000 galls.; iron, on a brick tower.

Distribution.—*Mains*, c. i., 1.7 miles. *Services*, w. i. *Taps*, 35. *Meters*, 1. *Hydrants*, Morgan, 19.

Consumption, 50,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $28,000. Debt, $21,500. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $500; city, none.

Management.—Chairman Com., E. C. Culver. Supt. and City Clerk, F. D. Gay

BURLINGTON, *Des Moines Co.* (Pop., 19,450; est., 30,000.) On Mississippi river, from which the ground rises gradually to an elevation of 200 ft. above the bluff. Settled in '33.

History.—Built in '77-8 by Burlington Water Co. It is unofficially reported that a new contract has recently been made with the city, and that the works will be extended. The original franchise was for 25 years. Engr., T. N. Boutelle. Contrs., Holly Mfg. Co., Lockport, N. Y. Sub-contrs.: for inlet pipe and crib, Truman Cowell, Muscatine; filter bed and buildings, A. W. Manning, Burlington.

Water Supply.—Mississippi river, filtered, by direct pumping.

Intake Crib and Pipe.—The crib is of pine timbers, planked on the sides and bottom. It is 250 ft. from the shore, in 19 ft. of water, and is connected with the filter bed by 235 ft. of 24-in. cast-iron pipe.

Filter Bed.—Is 20 ft. wide, 120 ft. long, with stone masonry walls. The bottom is an inverted arch of 18-in. versed sine. Over this is laid a floor of 2 by 4-in. scantling, with ½-in. spaces, and on this 3½ ft. of gravel and sand, graded in size. Water is admitted at the bottom and rising through the sand and gravel flows to the pump-well. The filter has not given entire satisfaction, and water has often been drawn directly from the river.

Pumping Machinery.—Dy. cap., 6,500,000 galls.: 3,000,000-gall. Holly quadruplex and 3,500,000-gall. Holly-Gaskill pump. The quadruplex pump has 19 in. steam and 10-in. water cylinders of 27-in. stroke. In Dec., '79, corn cobs were used for fuel with a reported saving of 50% over coal, the latter then costing $2.62 a ton.

Distribution.—*Mains*, c. i., 19½ miles. *Services*, w. i. Pipe and specials for original works furnished by Dennis Long & Co., Louisville, Ky., and H. R. Smith & Co., Columbus, O.; trenching and pipe-laying done by Russell & Alexander, Chicago, Ill. *Taps*, 1,477. *Meters*, 90. *Hydrants*, Holly, 215. *Valves*, Eddy.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 150 lbs.

Financial.—Cost, $200,000. Capital stock, $300,000. Debt, $186,000. Int., 6%. Ann. op. exp., withheld, but est., $15,000. Ann. rev.: consumers, withheld, but est., $28,000; city, $11,160. Hydrant rental, the city pays interest on the company's bonds.

Management.—Prest., Geo. D. Rand, Keokuk, Ia. V. Prest., Jno. Patterson. Supt., Chas. Wood.

CARROLL, *Carroll Co.* (Pop., 1,385; est., 2,500.) In lumber, sandstone, limestone and coal region.

History.—Built in '83-4 by town. Engrs. and Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., not given. Pump driven by windmill.

Tank.—Cap., 70,000 galls.

Distribution.—*Mains*, c. i., 0.7 miles. *Services*, iron. *Taps*, 12. *Meters*, none. *Hydrants*, 10.

Financial.—Cost, $10,500. Debt, $10,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $125.

Management.—Chf. Fire Dept., Jas. Thompson.

CEDAR FALLS, *Linn Co.* (Pop., est., 3,500.) On Cedar river, having good water-power used in manufacturing.

History.—Built in '87-8 by town. Engr., Chas. F. Loweth, St. Paul. Minn. Contrs., American Water & Gas Works Const. Co., Dubuque. The conduit was built by the town.

Water Supply.—Springs, pumping to tank.

Conduit.—Wooden, 1,100 ft. long, from springs to pump-well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington duplex high-pressure pump.

Tank.—Cap., 100,000 galls.; wooden, 30 ft. in diam. and 20 ft. high, on a 75-ft. iron trestle. Sub-contr., Wm. Lee, St. Paul, Minn.

Distribution.—*Mains*, 10 to 4-in. c. i., 3.7 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, about 50. *Meters*, Worthington, number not given. *Hydrants*, Mathews.

Consumption, not determined. *Pressure*: 80 lbs.

Financial.—Cost, $33,100. Bonded debt, about $30,000. Int. not given. Other data not determined.

Management.—Chn. Water Com., J. H., Jeffers

CEDAR RAPIDS, *Linn Co.* (Pop., 10,104; est., 20,000.) On Cedar river on slightly rolling ground which rises gradually from the river for about ½ mile to an elevation of from 25 to 50 ft. Has water-power, and quite extensive manufactories. Settled in '39; incorp. a city in '56.

History.—Built in '75-6 by Cedar Rapids Water Co. Engr., J. T. Cushing.

Water Supply.—Cedar river for fire protection and artesian well for domestic use, by direct pumping. The river has a drainage area of about 700 sq. m., and was formerly the only source of supply. There are three 5-in. wells, two 1,425 ft., and one 2,225 ft. deep. They yield over 1,100,000 galls. a day.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; McGowan, new 2,000,000-gall. high duty Worthington pumps.

Distribution.—*Mains*, c. i., 18 miles. *Services*, w. i., lead. *Taps*, 886. *Meters*, 5. *Hydrants*, Cummings, 140. *Valves*, Eddy.

Consumption, 950,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $200,000. Debt, $79,000. Int., 6 and 8%. Ann. op. exp., withheld, but est., $14,000. Ann. rev.: consumers, withheld, but est., $25,000; city, $16,000.

Management.—Prest., C. B. Souther. Secy., J. C. Broeksmit. Treas., W. Buchanan. Supt., C. J. Fox.

CHARLES CITY, *Floyd Co.* (Pop., 2,421; est., 3,500.) On Cedar river. Has water-power used in manufacturing.

History.—Built in '87 by town. Des. Engr., A. A. Richardson, Lincoln, Neb. Const. Engr., W. E. Hinsdale, Chicago, who represented the Eclipse Wind Engine Co., Beloit, Wis., who were the Contrs.

Water Supply.—Spring, impounded, by direct pumping. An emergency supply can be taken from the river.

Pumping Machinery.—Dy. cap., 2,225,000 galls.; a 1,000,000 and a 1,225,000 gall. Knowles pump driven by an 80 and a 40-in. turbine water wheel, under 10 ft. head.

Distribution.—*Mains*, 10 to 4-in. c. i., 2 miles. *Services*, *Taps* and *Meters*, not given. *Hydrants*, Galvin, 20. *Valves* and *boxes*, Galvin.

Consumption and *Pressure*, not given.

Financial.—Cost, $21,000. No further data given.

Management.—Not given. City Clerk, W. N. Crume. Report by W. E. Hinsdale, Chicago, Ill.

CLARINDA, *Page Co.* (Pop., 2,011; est., 3,500.) On Nodaway river. Has manufactories.

History.—Built in '85 and put in operation Jan. 1, '87, by town. Engr., A. A. Richardson, Lincoln, Neb.

Water Supply.—Driven wells, by direct pumping.

Pumping Machinery.—Worthington pump, dy. cap., 250,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, lead. *Taps*, 97. *Meters*, Crown, number not given. *Hydrants*, Galvin, 36.

Consumption, 75,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $42,000. Bonded debt, $35,000. Int., 5%. Ann. op. exp., $1,980. Ann. rev.: consumers, $1,000.

Management.—Com. of three. Pumping Engr., Jno. M. Stonebaker.

CLINTON, *Clinton Co.* (Pop., 9,052; est., 16,040.) On Mississippi river. Engaged in lumber and other manufacturing. Settled in '55; incorp. in '57.

History.—Built in '74-5 by Clinton Water-Works Co., when the population was about 7,500. Franchise runs till '94. Engr., Wm. C. Weir, deceased.

Water Supply.—Two flowing artesian wells, pumping to tank, and direct in case of fire. The wells are 5½ in. in diam., 1,100 ft. deep, have a pressure of 33 lbs. at the surface, and discharge into a receiving reservoir.

Water was formerly taken from the Mississippi river, passing from the intake pipe through a filter to the pumps.

Old Filter.—In two compartments, and consisted of sand and gravel in boxes, which could be lowered and raised for cleaning.

Reservoir.—Is 80 ft. sq. and 10 ft. deep.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; one compound, and one compound condensing duplex Gordon & Maxwell pump.

Tank.—Cap., 25,000 galls.; of iron, on a tower 100 ft. high.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and laid by E. C. Cowell. *Taps*, (in 86,) 300. *Meters*, (in '86,) 12. *Hydrants*, kind not given, 74.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 90 lbs.

Financial—Cost, $120,000. Capital stock, $200,000. Bonded debt, $70,000. Int., %. Ann. op. exp., (in '86,) $5,000. Ann. rev.: consumers, (in '86,) $15,000; city, $7,400. Hydrant rental, $100.

Management.—Prest., Chauncey Lamb. Secy. and Treas., J. C. Weston. Supt., Oliver Messer.

COLFAX, *Jasper Co.* (Pop., 620; est., 1,100.) On Chicaqua river, in coal region. Has medicinal springs.

History.—Built in '87 by town, under direction of the Council, without contractors, except for trenching.

Water Supply.—Three driven wells, pumping to reservoir. The wells are 3 in. in diam., have 5-ft. points, and are driven 19 ft. in gravel.

Pumping Machinery.—Dy. cap., 86,400 galls.; No. 7 Cameron pump, with 10-in. steam and 5-in. water cylinders of 15-in. stroke; 25 H. P. boiler.

Reservoir.—Cap., about 70,000 galls.; 24 ft. in diam. and 20 ft. deep, and is 2,840 ft. from, and 140 ft. above the pump.

Distribution.—*Mains*, 6 and 4-in. c. i., 4,000 ft. *Services*, 1 and ¾-in. w. i., 2,400 ft. Pipe and specials from Dennis Long & Co., Louisville, Ky. Trenching done by P. H. Cross, Colfax. *Taps*, 47. *Meters*, none. *Hydrants*, Ludlow, 9. *Valves*, Ludlow.

Consumption, 12,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $5,800. Bonded debt, $6,000. Int., 6%. Ann. op. exp., $200. Ann. rev.: consumers, $400; city a five-mill tax is assessed to provide for a sinking fund.

Management.—Comr. and Supt., Geo. A. Goodrich.

COUNCIL BLUFFS, *Pottawattomie Co.* (Pop., 18,063; est., 35,000.) On Missouri river at mouth of Indian creek, and opposite Omaha, Neb. On plain at foot of high bluffs, and on the bluffs, which are intersected with ravines.

History.—Built in '82-3 by Council Bluffs City Water-Works Co., under a 20 years' franchise. Des. Engr., H. P. M. Birkinbine. Const. Engr., Harry Birkinbine, the present Mgr. and Chf. Engr. All labor done by the day without Contrs.

Water Supply.—Missouri river, pumping to two subsiding reservoirs, and re-pumping to a distributing reservoir.

Conduit.—When the works were constructed an oak conduit, 3 by 4 ft., by 2,300 ft. long, conveyed water from the channel of the river to the pump well.

Pumping Machinery.—Dy. cap., 7,500,000 galls.; Andrews centrifugal pumps driven by Westinghouse engines, and two Knowles duplex pumps of 30-in. steam and 24-in. water cylinders of 16 in. stroke. The Knowles pumps lift the water from the subsiding to the distributing reservoir.

Subsiding Reservoirs.—Cap., 12,000,000 galls.; two of equal cap.

Distributing Reservoir.—Cap., 4,000,000 galls.: on the bluff.

Distribution.—*Mains*, c. i., 25 miles. *Services*, lead. Pipe and specials furnished by Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, about 1,400, *Meters*, 73. *Hydrants*, Ludlow, Chapman, 201.

Consumption, 1,700,000 galls. *Pressure*: Ordinary, 82 lbs. Fire, 125 lbs.

Financial.—Cost, $625,270. Capital stock, $1,000,000. Bonded debt, $500,000. Int., 6%. Ann. op. exp., $10,250. Ann. rev.: consumers, $29,370; city, $20,675. Hydrant rental, $100 each for 200, $75 for each additional.

Management.—Prest., Robt. Sewell. Treas., Geo., P. Sheldon. Both of New York City. Gen. Mgr. and Chf. Engr., Harry Birkinbine.

DAVENPORT, *Scott Co.* (Pop., 21,831; est., 31,000.) On Mississippi river, at the foot of the Upper rapids, and opposite Rock Island, Moline and Milan, Ill.; at foot and on slope and top of a bluff rising 180 ft. above low water. In high water the river rises 18¾ ft. Settled in '33; incorp. a city in '39.

History.—Built in '74 by Davenport Water Co., Michael Donahue being connected with the enterprise.

Water Supply.—Mississippi river, by direct pumping, and by pumping to reservoir, there being a high and low service, and two pumping stations.

Intake.—Conduit of brick in cement, 3½ by 3 ft., extending under the bed of the river 250 ft. from low water mark on the shore.

Pump-Well.—At end of conduit, 15 ft. in diam. and 30 ft. deep.

Pumping Machinery.—*Main Station*: Dy. cap., 6,000,000 galls.; two Clapp & Jones compound condensing plunger pumps of 12-in. bore and 36-in. stroke. The first eight years two horizontal piston pumps of 17-in. bore and 72-in. stroke, driven by two horizontal engines were used. The pumps were built by Todd & Rafferty, Patterson, N. J., and the engines by M. Donahue, Davenport. *High Service Station*: one 5,000,000-gall. high duty Worthington pump.

Reservoir.—Cap. 5,000,000 galls.

Distribution.—*Mains*, c. i. 28 miles. *Services*, galv. i. *Taps*, 1,523. *Meters*, 40. *Hydrants*, kind not given, 266; 10 are private.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $860,000. Capital stock, $1,000,000. No debt. Ann. op. exp., withheld but est., $25,000. Ann. rev.: consumers, withheld, but est., $40,000; city, $10,240. Hydrant rental, $40.

Management.—Prest., Nicholas Kuhnen. V. Prest. and Secy., Jas. P. Donahue. Supt. and Chf. Engr., Thos. N. Hooper.

DECORAH, *Winneshiek Co.* (Pop., 2,951; est., 3,500.) On Iowa river on rolling ground. Engaged in manufacturing. Settled in '54; incorp. a city in '75.

History.—Built in '81 by city. Const. Engr. and Cont., G. E. Beach, Minneapolis, Minn.

Water Supply.—Surface well, pumping to reservoir, with provision for direct pumping. The well is 20 ft. in diam. and 30 ft. deep, in gravel.

Pumping Machinery.—Dy. cap., 150,000 galls.; Knowles pump.

Reservoir.—Is 60 ft. in diam. and 20 ft. deep; of stone in cement, with concrete bottom. Contrs., Haskins, Shultz & Kay, Decorah.

Distribution.—*Mains*, c. i., 2 miles. *Services*, galv. i. *Taps*, 40. *Meters*, none. *Hydrants*, Chapman, 18. *Valves*, Chapman.

Consumption, 32,000. *Pressure*: 100 lbs.

Financial.—Cost, about $23,000. Debt, $16,000. Int., 5 and 6%. Ann. op. exp., $1,196. Ann. rev.: consumers, withheld, but est., $1,000; city, none.

Management.—Chairman Com., Alex. McKay. No Supt.

DENISON, *Crawford Co.* (Pop., 1,441; est., 2,000.) On Boyer river.

History.—Built in '83 by town. Engr., G. E. Beach, Minneapolis, Minn.

Water Supply.—Surface well, pumping to tank.

Pumping Machinery.—Dy. cap., 72,000 galls.; Smith & Vaile pump, driven by a windmill.

Tank.—Cap., about 100,000 galls.; 30 ft. in diam. and 20 ft. high, raised 40 ft. above the ground, making its total elevation above the town 125 ft.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 52. *Meters*, none. *Hydrants*, Chapman, 10. *Valves*, Chapman.

Consumption, 12,000. *Pressure*: Ordinary, 35 lbs. Fire, 35 lbs.

Financial.—Cost, $11,000. Debt, $7,500. Int., 6%. Ann. op. exp., $1,316. Ann. rev.: consumers, $540; city, none.

Management.—Supt. and Chairman of Com., N. J. Wheeler.

DES MOINES, *Polk Co.* (Pop., 22,408; est., 45,000.) At junction of Des Moines and Raccoon rivers. Incorp. a city in '57.

History.—Built in '71 by Des Moines Water-Works Co., under a perpetual charter.

Water Supply.—Ground water on Raccoon river, by direct pumping.

Filter.—Consisted of cylindrical iron chambers, 12 ft. below the bed of the river, with tops tightly covered and bottoms open for water to filter in through sand and gravel. It is not stated whether this is now in use.

Pumping Machinery.—Dy. cap., 11,000,000 galls.; 5,000,000-gall. Holly-Gaskill and 6,000,000-gall. Worthington pump. Formerly a gang of eight Holly piston pumps were used.

Distribution.—*Mains*, c. i., 40 miles. *Services*, lead. *Taps*, (in '86,) 2,500. *Meters*, 1,000. *Hydrants*, kind not given, 400. *Pressure-recording gauge*, Edson.

Consumption, 2,000,000 galls. *Pressure*: 80 to 135 lbs.

Financial.—Cost, $1,000,000. Capital stock, $500,000. Bonded debt, $350,000. Int., 6%. Ann. op. exp., in '86, $20,000. Ann. rev.: consumers, in '86, $20,000; city, in '86, 8,000. The city pays a certain sum per mile per year for water; amount not given, but probably $600.

Management.— Prest., J. S. Polk. Secy. and Mgr., A. N. Denman.

DUBUQUE, *Dubuque Co.* (Pop., 22,254; est., 30,000.) On Mississippi river on a plateau in a mining district. Founded in '33; incorp. in '41.

History.—Built in '71 by Dubuque Water Co. Des. Engr., —— Pilsbury.

Water Supply.—An abandoned tunnel for draining mines, by gravity to and from reservoir.

Tunnel.—In bluff 2½ miles from city. It is a mile long, from 100 to 200 ft. below the surface and 80 to 90 ft. below mineral strata. Much of its course is through solid rock, from fissures in which water at a temperature of 45 degrees F. flows.

Conduit to reservoir.—An arched channel 5 ft. wide and 5 ft. long extends from the mouth of the tunnel to the reservoir, and forms an additional storage cap. of about 150,000 galls.

Dam.—Built across a ravine to form reservoir. No further data given.

Reservoir.—Cap., 1,600,000 galls.; 55 by 185 ft. by 18 ft. deep, and from 85 to 120 ft. above city. Surface water is excluded by stone walls.

Distribution.—*Mains*, c. i., 18 miles. *Services*, lead. *Taps*, 675. *Meters*, 15. *Hydrants*, Holly, 158. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: 40 lbs.

Financial.—Cost, withheld, but est., $275,000. Capital stock, in '81, $300,000. No bonds. Ann. op. exp., withheld, but est., $5,000. Ann. rev.: consumers, withheld, but est., $13,500; city, $10,400. Hydrant rental, $75 each for 100, and $50 for each additional.

Management.—Prest., S. Chamberlain, Secy. and Treas. and Mgr., N. W. Kimball.

ELDORA, *Hardin Co.* (Pop., 1,584; est., 2,500.) On Iowa river. Manufactures wagons, pottery, tile and brick. Settled in '52; incorp. a city in '58.

History.—Built in '83 by city. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co. Both of Batavia, Ill.

Water Supply.—Combined surface and driven well, pumping to tank. The well is 10 ft. in diam. for 40 ft., then has a 6-in. well driven 100 ft. deeper.

Pumping Machinery.—Dy. cap., about 22,000 galls.; pump is of 4-in. bore and 18-in. stroke, made by above contractors, and is driven by a 22 ft. Halladay windmill.

Tank.—Cap., about 100,000 galls.; 30 ft. in diam. and 20 ft. high, on a timber trestle 40 ft. high.

Distribution.—*Mains*, c. i., 3,000 ft. *Services*, w. i. *Taps*, 8. *Meters*, none. *Hydrants*, Holly, 6.

Consumption, not given. *Pressure*: 26 lbs.

Financial.—Cost, $7,800. Debt, $6,000. Int., 7%. Ann. op. exp., none. Ann. rev.: consumers, $100; city, none.

Management.—Supt., J. S. Hailey. Report by Thos. G. Alvord, Chn., Com'

FAIRFIELD, *Jefferson Co.* (Pop., 3,086; est., 4,000.) On Big Cedar river, on a prairie. Engaged in manufacturing and trade.

History.—Built in '83-4 and owned jointly by the city and Geo. B. Inman. City rents the works, for $4,000 a year. All of the rental above 6%. interest on remaining debt applies to purchase of the works, which, at present rate, will be wholly owned by city in '97. Des. Engrs., Chester B. Davis, Chicago, and Geo. B. Inman, New York City, the latter designing the pumping plant and stand-pipe. Const. Engr., W. Kiersted, Kansas City, Mo. Contrs., Inman Bros., New York City.

Water Supply.—Surface water impounded by a dam, pumping to stand-pipe.

Impounding Dam and Reservoir.—The dam is of earth and masonry, 500 ft. long and 35 ft. high. Cap. of reservoir is not given.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake duplex pump, and KanSas City boiler.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i. *Taps*, 155. *Meters*, 1. *Hydrants*, Ludlow, 33. *Valves*, Ludlow.

Consumption, 53,000 galls. *Pressure*: Ordinary, 27 lbs. Fire, 125 lbs.

Financial.—Cost, $53,000. Capital stock, $25,000. Bonded debt, $30,000. Int., 5%. Ann. op. exp., $8,000, including $4,000 for rental of the works. Ann. rev.: consumers 1,500; city, none.

Management.—Com.: A. B. Scott, Jno. Davies and H. L. Brown. Mgr., Geo. B. Inman, New York City. Report by T. F. Higley.

FORT DODGE, *Webster Co.* (Pop., 3,586; est., 6,500.) On Des Moines river, and has water-power.

History.—Built in '80-1 by city. Engr., T. N. Boutelle.

Water Supply.—Des Moines river, filtered, by direct pumping.

Filter. Plate iron cylinder, 20 ft. in diam., closed at top and open at bottom. Was sunk in gravel of river bottom. It has yielded 500,000 galls. a day. From this water flows to a pump-well. A 14-in. pipe connects directly with the river, and a valve in it is automatically opened when the capacity of the filter is exhausted.

Pumping Machinery.—Cap., not given. Cope and Maxwell pump, with 16-in. steam and 10-in. water cylinders of 24-in. stroke.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. *Taps*, 145. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $2,4000; city, none.

Management.—City Clerk, C. M. Hamilton.

FORT MADISON, *Lee Co.* (Pop., 4,679; est., 9,000.) On Mississippi river. Has extensive manufactories.

History.—Built in '85 6 by Fort Madison Water Co. under a 20 years' exclusive franchise. Des. Engr., Geo. B. Inman. Contrs., Inman Bros. Both of New York City.

Water Supply.—Mississippi river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake duplex compound condensing pump, and horizontal tubular boiler.

Reservoir.—Cap., 1,500,000 galls.; 120 by 180 ft., by 16 ft. deep.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, w. i. *Taps*, 185. *Meters*, 8. *Hydrants*, Ludlow, 73. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 125 lbs.

Financial.—Cost, about $85,000. Capital stock, $100,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $3,000; city, $4,980. Hydrant rental, $75 each for 40, $60 for each additional.

Management.—Prest. G. D. L'Huillier. Secy, H. M. Gilligan, New York City. Supt., P. M. Hanley.

GLADBROOK, *Tama Co.* (Pop., est., 700.) On Wolf creek. Incorp. a town in '80.

History.—Built in '83 by town. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Creek and well, pumping to tank. A 4-in. drain pipe, 50 ft. long, was laid from the creek to a well 4 ft. in diam. and 20 ft. deep, from which water is pumped.

Pumping Machinery.—Dy. cap., 5,000 galls.; double-acting force pump driven by a windmill.

Tank.—Cap., 30,000 galls.; 18 ft. in diam, and 16 ft. high, and 100 ft. above pump.

Distribution.—*Mains*, Wyckoff wood, 1½ mile, *Services*, iron. *Taps*, 1. *Hydrants*, Holly, 2.

Financial.—Cost, $3,000. Debt, $2,500. Int., 6%. Ann. op. exp., very light. No rev.

Management.—Supt., P. R. Howard. Report by A. O. Armington.

HOLSTEIN, *Ida Co.* (Pop., est., 800.)

History.—Built in '86 for fire protection by town. Contrs., U. S. Wind Engine & Pump Co., Batavia Ill.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Knowles duplex pump, with 8-in. steam and 6-in. water cylinders of 12-in. stroke.

Tank.—Is 18 by 24 ft.

Distribution.—*Mains*, 6 and 4-in. c. i., 1,600 ft. *Hydrants*, 4.

Financial.—Cost, not given. Debt, $6,000. Int., 6%.

Management.—Chairman Com., Wm. Wentz. Report by G. A. Case, Ida Grove.

IDA GROVE, *Ida Co.* (Pop., 759; est., 1,800.) On Maple river. Settled in '78; incorp. a town in '79.

History.—Built in '82 by town. Des. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co. Both of Batavia, Ill.

Water Supply.—Driven wells, pumping to tank. There are 11 wells, each 2 in. in diam. and varying in depth from 25 to 28 ft. They are connected to a common suction pipe. As late as '85 water was also taken from a surface well 8 ft. in diam. and 18 ft. deep.

Pumping Machinery.—Dy. cap., not given; double-acting pump of 4 in. bore and 18 in. stroke, driven by a 2 -ft. windmill, both furnished by the Contrs.; a Knowles pump of 12 in. steam and 8-in. water cylinders of 12 in. stroke, is used when there is no wind, or in case of fire.

Tank.—Cap., 100,000 galls.; of wood, 30 ft. in diam. and 20 ft. high, on a 20-ft. timber trestle.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 67. *Meters*, none. *Hydrants*, Chapman, 11. *Valves*, Chapman.

Consumption, 12,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 125 lbs.

Financial.—Cost, $10,380. Debt, $7,500. Int., 5%. Ann. op. exp., $250. Ann. rev.: consumers, $650; city, $400.

Management.—Chairman Com., Geo. A. Case.

INDEPENDENCE, *Buchanan Co.* (Pop., 3,128; est., 3,450.) On Wapsipinicon river.

History.—Built in '86-7 by town. Des. Engr., E. Smedley, Dubuque. Const. Engr., A. D. Guernsey, Independence. Contrs., National Iron & Brass Works, Dubuque.

Water Supply.—Driven wells and Wapsipinicon river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound condensing duplex pumps, built by the Contrs., and two horizontal tubular boilers.

Distribution.—*Mains*, heavy c. i., 5 miles. *Services*, w. i. *Taps*, 90. *Meters*, 12. *Hydrants*, Ludlow, 40. *Valves*, Ludlow.

Consumption, 125,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 200 lbs.

Financial.—Cost, $40,000. Debt, $40,000. Int., 5%. Ann. op. exp., $2,369. Ann. rev.: consumers, $2,857; city, none.

Management.—Secy. of Com., R. Brewer. Supt., A. D. Guernsey.

IOWA CITY, *Johnson Co.* (Pop., 7,123; est., 8,000.) On Iowa river on irregular ground, the highest point being 105 ft. above the river. Engaged in manufacturing. Settled in '39; incorp. a city in '83.

History.—Built in '82 by Iowa City Water Co., under a 20 years' franchise. Engr. and Contr. for labor, T. Cowell, Muscatine.

Water Supply.—Wells, 150 ft. deep, by direct pumping. Water was formerly taken from Iowa river, passing through a filter bed. It is not stated whether the river water is now used.

Filter Bed.—Consists of 3 ft. of stone, gravel and sand in a brick chamber 75 by 14 ft., by 12 ft. deep.

Pumping Machinery.—Holly pump, dy. cap., 3,500,000 galls.

Distribution.—*Mains*, c. i., 9½ mlies. *Services*, w. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 320. *Meters*, not given. *Hydrants*, Holly, 92.

Consumption, 450,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $125,000. Capital stock, $55,000. Bonded debt, $70,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $3,700; city, $5,300. Hydrant rental, $5,300 for 92, or about $68 each; $50 for each additional.

Management.—Prest., G. B. Denison. Supt., Secy. and Treas., T. Cowell.

KEOKUK, *Lee Co.* (Pop., 12,117; est., 18,000.) On Mississippi river, on limestone bluffs 130 ft. above the river. Has extensive river commerce. Founded in '40.

History.—Built in '77-8 by Keokuk Water-Works Co., under a 20 years' franchise. Managed by American Water-Works Co., Ltd., Pittsburgh, Pa. Des. Engr., W. C. Stripe.

Water Supply.—Mississippi river, filtered, by direct pumping. Water is aerated in passing down the 12-mile rapids, above the city, and surface drainage from the other side of the river is intercepted by a canal built by the U. S. Government.

Intake.—Of 20-in. cast-iron, extending from mid-channel to the filter.

Filter.—Is 15 by 50 ft., of brick in cement, with bottom 6 ft. below low water; a floor of timber joists on edge, ¼ in. apart, was built 4 ft. above the bottom, and on this is 2½ ft. of broken stone, charcoal, gravel, coarse and fine sand. The filter has worked fairly well.

Pumping Machinery.—Dy. cap., 3,500,000 galls.; quadruplex Holly pump, with 14½ steam and 8-in. water cylinders, all of 22-in. stroke, and 1,500,000-gall. compound Worthington pump.

Distribution.—*Mains*, c. i., 14½ miles. *Services*, galv. i. *Taps*, withheld, but in '84 there were 470. *Meters*, withheld, but in '84 there were 17. *Hydrants*, kind not given, 95.

Consumption, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, withheld. Capital stock, $500,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp. and rev., withheld. Hydrant rental, $75.

Management.—Prest., J. H. Purdy. Secy., W. S. Kuhn, Pittsburgh, Pa. Treas., Jno. McIntyre. Supt., Omar O. Jones.

KNOXVILLE, *Marion Co.* (Pop., 2,577; est., 3,000.) Has water-power, and is in a coal and timber region.

History.—Built in '87 by town; put in operation Jan. 1, '88. Engr., A. A. Richardson, Lincoln, Neb.

Water Supply.—Source not given, pumping from reservoir to stand-pipe.

Reservoir.—Cap., 6,000,000 galls.

Pumping Machinery.—Dy. cap., 240,000 galls.; duplex Blake pump. Boiler from H. C. Darby, Kansas City, Mo.

Stand-Pipe.—Cap., 93,000 galls.; 12 ft. in diam. and 110 ft. high. Contr., H. C. Darby, Kansas City, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles. *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O. *Taps*, 9. *Meters*, not given. *Hydrants*, Galvin, Ludlow, 25. *Valves*, Galvin.

Consumption, 10,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 140 lbs.

Financial.—Cost, $28,000. Bonded debt, $28,000. Int., 5 and 6%. Other data not determined.

Management.—Not given. Report by T. Y. Yilson.

LANSING, *Allamakee Co.* (Pop., 1,811; est., 1,800.) On Mississippi river.

History.—Built in '77 by Lansing Artesian Well Co. Contrs., Snow Bros.

Water Supply. — Two flowing wells,, by gravity. The wells yield over 50,000 galls. a day.

Distribution.—*Mains*, c. i., ½ mile. *Services*, galv. i. *Taps*, 50. *Meters*, none. *Hydrants*, 5.

Consumption, 50,000 galls. *Pressure*: 45-ft. head.

Financial.—Cost, $7,500. Capital stock, $4,200. No debt. Ann. op. exp., $150, Ann. rev.: consumers, $600; city, $200. Hydrant rental, $40.

Management.—Prest., M. Kerndt. Supt., Ed. Boeckh.

LOGAN, *Harrison Co.* (Pop., 644; est., 1,000.) On Boyer river.

History.—Built in '84 by village.

Water Supply.—Source not given. Water is pumped to a reservoir.

Pumping Machinery.—Cap., not given. Power is furnished by a windmill for nine months in the year. An 8 H. P. engine is used when necessary.

Reservoir.—Cap., about 90,000 galls.; on hill 100 ft. above street grade.

Distribution.—(For '86.) *Mains*, Kalamein i., w. i., 1.3 miles. *Services*, galv. i. *Taps*, 60. *Meters*, none. *Hydrants*, 18.

Consumption, unknown. *Pressure*: Ordinary, 46 lbs.

Financial.—(For '86.) Cost, $7,000. Debt, $4,350. Int., 7%. Ann. op. exp. $175. Ann. rev.: consumers, $160; city, none.

Management.—Town Recorder, W. W. Stern.

LYONS, *Clinton Co.* (Pop., 4,095; est., 5,800.) On Mississippi river, two miles from Clinton. Has manufactories. Settled in '40; incorp. in '65.

History.—Built in '76 by Lyons Water-Works Co. Engr., W. C. Weir.

Water Supply.—Mississippi river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Knowles pumps of 24-in. steam and 12-in. water cylinders, of 24-in. stroke, and two flue boilers.

Reservoir.—Cap., not given; 100 ft. in diam., in excavation and embankment lined with 2 ft. of puddled clay on which is a brick pavement.

Distribution.—*Mains*, c. i., w. i., 8 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, some Mathews, 58.

Consumption, 250,000 galls. *Pressure*: Ordinary, 47 lbs. Fire, 150 lbs.

Financial.—Cost, $70,000. Capital stock, $36,000. Debt, $26,000, of which $20,000 is in bonds. Int., 6%. There is a cash surplus of $18,000. Ann. op. exp., $1,600. Ann. rev.: consumers, $3,000; city, $3,000. Hydrant rental, $100 each for 30, and $50 each for 10 additional. The city is limited to a five-mill tax for fire protection, and as its assessed valuation is low it cannot pay the full amount due for 40 hydrants. The balance due each year is reckoned by the company as a debt against the city.

Management.—Prest., D. J. Batchelder. Secy., S. W. Gardiner. Gen. Mgr., Geo. S. Gardiner. Treas., Wm. Holmes. Supt., J. K. P. Balch.

McGREGOR, *Clayton Co.* (Pop., 1,602; est., 1,800.) On Mississippi river. Has railroad repair shops.

General Description. — The McGregor Artesian Well Co. has ¾ miles of pipe laid through business part of town, with 5 hydrants. Date built, not given. Used for fire protection only. No rev. Prest., J. P. Patrick. Report by Arthur Hotel.

MAQUOKETA, *Jackson Co.* (Pop., 2,467; est., 3,300.) On Maquoketa river. Has manufactories.

History.—Built in '83-4 by city. Des. Engr., Geo. C. Morgan, Chicago, Ill. Const. Engr. and Contr., Travers Daniels, Columbia, Tenn.

Water Supply.—Well, pumping to stand pipe and direct. The well is in sand, 500 ft. from the river, is 22 ft. in diam. and 30 ft. deep, and lined with brick. At the lowest stage of the river water stands 11 ft. deep in the well.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake duplex pump, with 18-in. steam cylinders, 10-in. plungers and 12-in. stroke. Either side of the pump can be run independently of the other.

Stand-Pipe.—Cap. about 60,000 galls.; wrought iron, 12½ ft. in diam. and 80 ft. high, 175 ft. above and ¾ miles from the pump.

Distribution.—*Mains*, 8 to 4-in. c. i., 2.6 miles. *Services*, w. i. Pipe and specials from Ohio Pipe Co., Columbus, O. and National Tube Works Co., Chicago, Ill. *Taps*, 109. *Meters*, none. *Hydrants*, Ludlow, 26. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $32,537. Bonded debt, $16,500. Int., 6%. Ann. op. exp., $1,645. Ann. rev.; consumers, $1,190; city, $1,181.

Management.—Three Comrs. Secy., D. A. Fletcher. Pumping Engr., H. P. Morse.

MARENCO, *Iowa Co.* (Pop., 1,738; est. 2,000.) On Iowa river.

General Description.—Built for fire protection in '75 by village. Water is taken from the Iowa river. There is a Holly pump located in a mill, and in case of fire this is connected with the water wheel furnishing power to the mill. There are 2 miles of mains and 10 hydrants. The cost is placed at $25,000, and the ann. op. exp., $200. No rev. Report by Jas. Hendry and G. Holm.

MARION, *Linn Co.* (Pop., 1,939; est., 4,000.) Is 6 miles from Cedar Rapids.

NOTE:-There is a direct pumping system here owned by a company. Prest., B. F. Seaton. V. Prest., N. E. Ives. Treas., A. L. Daniels. Secy., L. M. Rupert. All requests for further information have been ignored.

MARSHALLTOWN, *Marshall Co.* (Pop., 6,240; est., 10,000.) On Iowa river. Engaged in manufacturing and trade.

History.—Built in '76 by city. Engr., Thos. N. Boutelle. Contrs., S. D. Carpenter & Co., Ottumwa.

Water Supply.—Iowa river, filtered, by direct pumping. The river flows through an alluvial soil.

Filter.—A 16-in. pipe extends from the river to a basin 20 by 30 ft., by 15 ft. deep, in which is gravel and charcoal.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Knowles pumps of 22-in. steam and 12-in. water cylinders of 24-in. stroke.

Distribution.—*Mains*, c. i., 12½ miles. *Services*, iron, lead. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky. *Taps*, 450. *Meters*, 1. *Hydrants*, Chapman, 86. *Valves*, Chapman.

Consumption, 600,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $85,000. Debt, $37,000. Int., 8%. Ann. op. exp., $6,000. Ann. rev.: consumers, $6,000.

Management.—Secy. and Gen. Mgr., J. G. Trotten. Report by E. A. Harris.

MASON CITY, *Cerro Gordo Co.* (Pop., 2,510; est., 3,500.) On Lime river.

History.—Built in '85 by town. Des. Engr. Chester B. Davis, Chicago, Ill. Const. Engr., Jno. West, Mason city.

Water Supply.—Springs and Lime river, by direct pumping. The river is drawn upon in case of fire.

Receiving Reservoir.—Cap., about 150,000 galls. The springs are at the foot of a hill, and water is led from them to the reservoir.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Blake duplex pumps, each having 8½-in. plungers of 12-in. stroke, and one being driven by a compound engine with 8½ and 12-in. cylinders, and the other by an engine with a 16 in. cylinder, all of 12-in. stroke.

Distribution.—*Mains*, c. i., 2¾ miles. *Services*, lead, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 26. *Valves*, Ludlow.

Consumption, 206,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, $26,000. Bonded debt, $26,000. Int., 6%. Ann. op. exp., $2,400. Ann. rev.: consumers, $3,400; city, $2000.

Management.—Chn. Water Board, D. J. Stewart. No. Supt. City Clerk, A. R. Sale.

MONTICELLO, *Jones Co.* (Pop., 1,877; est., 2,000.) On Maquoketa river, on an elevated terrace called the "second bottom" of the river. Has furniture and other factories. Settled in '53; incorp. in '67.

History.—Built in '78 by city. Des. Engr., Thos. N. Boutelle.

Water Supply.—Artesian well, pumping to reservoir. The well is 1,200 ft. deep, and extends 40 ft. into Potsdam sandstone.

Pumping Machinery.—Dy. cap, not given; a 6-in. Blake pump, and a 30 H. P. boiler. Contrs., Pond Engineering Co. St. Louis, Mo.

Reservoir.—Cap., 25,000 galls.; of stone, 100 ft. above town.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, galv. i. *Taps*, 135. *Meters*, none. *Hyrants*, Holly, 20.

Consumption, 55,000 galls. *Pressure*: 45 lbs.

Financial.—Cost, $20,000. Debt, $12,000. Int, 7%. Ann, op. exp., $1,185. Ann. rev.: consumers, $1,171; city, $832.

Management.—Three Comrs. Supt., J. D. Graves.

MOUNT PLEASANT, *Henry Co.* (Pop., 4,410: est., 4,000.) Manufactures scales and wheel-scrapers.

History.—Built in '84 by Mt. Pleasant Water-Works Co.

Water Supply.—Big creek, filtered, pumping to stand-pipe.

Pumping Machinery.—Cap. not given; one duplex and one high-pressure Blake pump.

Filter.—Hyatt, dy. cap., 300,000 galls.

Stand-Pipe.—Cap., 39,000 galls.; 10 ft. in diam. and 80 ft. high.

Distribution.—*Mains*, c. i., 6 miles. *Services*, not given. Pipe and specials from Addyston (O.) Pipe and Steel Co., and trenching and pipe-laying done by R. B. Carothers, Newport, Ky. *Taps*, 60. *Meters*, 5. *Hydrants*, Crane, 50. *Valves*, Crane.

Consumption, not given. *Pressure*: Ordinary, 35 lbs. Fire, 80 lbs.

Financial,—Capital stock, $130,000. No further data given.

Management.—Prest. and Treas., H. M. Phillips, Springfield, Mass. Secy., J. H. Hewson. Supt., C. M. Glover.

MUSCATINE, *Muscatine Co.* (Pop., 8,295; est., 12,000.) On Mississippi river, on a rocky bluff. Has extensive trade and manufactories. Settled in '36; incorp. a city in '53.

History.—Built in '75-6 by Muscatine Water-Works Co., under a 30 years' franchise, Des. Engr., Wm. C. Weir. Const. Engr., T. E. Cowell, Muscatine.

Water Supply.—Mississippi river, filtered, pumping to reservoir and direct.

Filter.—Gravel, 15 ft. sq.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two direct-acting Cope & Maxwell pumps, with 16-in. steam cylinders and 10-in. water plungers, all of 30-in. stroke.

Reservoir.—Cap., 3,000,000 galls.; in excavation and embankment, 16ft. deep, 172 ft. above high water. Inner slopes are 1½ to 1, covered with puddle, and it is lined with brick in cement.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i., lead. *Taps*, 350. *Meters*, 32. *Hydrants*, Chapman, Ludlow, 54. *Valves*, kind, do.

Consumption, 200,000 galls. *Pressure*: Ordinary, 72 lbs. Fire, 150.

Financial.—Cost, $80,000. Capital stock, $33,000. Bonded debt, $27,000. Int., 4%. Ann. op. exp., $3,700. Ann. rev.: consumers, $5,500; city, $5,000. *Hydrants*, $75.

Management.—Prest., Alex. Jackson. Secy., J. Carscaddan. Supt., W. Molis.

NEOLA, *Pottawattamie Co.* (Pop., 668; est., 800.)

History.—Built in '87 by village. Des. Engr., —— Fairbanks, St. Louis, Mo. Const. Engr., S. K. Felton, Omaha. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Well, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 450,000 galls.; Knowles pump and Porter boiler.

Tank.—Cap., about 60.000 galls.

Distribution.—*Mains*, c. i., 0.8 miles. *Services*, lead. *Taps*, 15. *Meters*, none. *Hydrants*, Eclipse 7. *Valves*, Galvin.

Consumption, not given. *Pressure*; Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $55,000. Ann. op. exp., about $800. Other data not given.

Management.—Secy., H. I. Irwin.

NEVADA, *Story Co.* (Pop., 1,541; est., 1,600.)

History.—Built in '88 by village. Des, Engr., Wm. Burnham, Batavia, Ill. Const. Engr., and Contr., Fremont Turner, Nevada.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., 144,000 galls.; Curtis pump, driven by a windmill.

Tank.—Cap., 97,000 galls.; wooden, 30 ft. in. diam. and 20 ft high. On a wooden trestle. the tank being about 110 ft. above and 2,550 ft. from the pump.

Distribution.—*Mains*, 8 and 6-in. c. i., 1¼ miles. *Services*, iron. Pipe from Detroit (Mich.)Pipe and Foundry Co. *Taps*, 3. *Meters*, none, *Hydrants*, Galvin, 18 *Valves*, Galvin.

Consumption, not determined. *Pressure*: Ordinary, 43 to 50 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 5½%.

Management.—Supt., Fremont Turner.

NEWTON, *Jasper Co.* (Pop., 2,607; est., 3,500.)

History.—Built in '84 by town. Des. Engr., Jos. Stevens. Const. Engr., Fairbanks, Morse & Co., Chicago, Ill. Contr. for pumping machinery, pipe and specials, A. K. Brown; for pipe-laying, Wesley Roberts.

Water Supply.—Surface and artesian wells, pumping to reservoir. The artesian well was sunk in '88.

Pumping Machinery.—Cap. not given; Smith & Vaile pump, and upright boiler.

Reservoir—Cap., about 100,000 galls.

Distribution.—*Mains*, 2 miles. *Taps*, 10. *Hydrants*, 15.

Pressure: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $20,000. Debt, $16,000. Int., 6%. Ann. op. exp., not given, but est., $1,000. Ann. rev., est., $300.

Management.—Supt., Jos. Stevens. Chf. Fire Dept., C. P. Axtell. Pumping Engr., Wm. Richards.

NOTE:—No further data given.

ODEBOLT, *Sac Co.* (Pop., 637; est., 1,200.) On Odebolt creek on a rolling prairie. Settled in '77.

History.—Built in '84 by Odebolt Water-Works Co. Des. Engr., Wm. H. Burnham. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Driven wells, pumping to tank. Water was formerly taken from a well 6 ft. in diam. and 30 ft. deep.

Pumping Machinery.—Cap., not given; Knowles steam pump and a pump of 4-in. bore and 18-in. stroke, driven by a 22-ft. windmill.

Tank.—Cap., 54,000 galls.; 24 ft. in diam. and 16 ft. high, on a 40-ft. timber trestle' the ground being 60 ft. above the town.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 20. ***Meters***, none. *Hydrants*, Bailey, 10. *Valves*, Eddy.

Consumption, not given. *Pressure*: 60 lbs.

Financial.—Cost, $10,000. Capital stock, $20,000. No debt. Ann. op. exp., $125 Ann. rev.: consumers, $300; city, $500. Hydrant rental, $50 each.

Management.—Prest., H. C. Wheeler. Secy., W. A. Helsell. Supt., Jos. Mattes.

OSKALOOSA, *Nahaska Co.* (Pop., 4,598; est., 8,000.) Engaged in manufacturing and coal mining.

History.—Built in '80-1 by Oskaloosa Water Co., under a franchise running 20 years from '80. Contr., T. E. Cowell, Muscatine.

Water Supply.—Surface water, filtered, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Holly pumps and one Deane, and Holly boilers.

Filter.—Hyatt, dy. cap., 500,000 galls.

Stand-Pipe.—Cap., 235,000 galls.; steel, 20 ft. in diam. and 120 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 12 miles. *Services*, galv. i., block i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 400. *Meters*, 12. *Hydrants*, Ludlow, 58. *Valves*, Eddy.

Consumption, 450,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, about $150,000. Capital stock, $250,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers, $8,000; city, $4,900. Hydrant rental, $100 each for 40, and $50 for each additional.

Management.—Prest., Jas. Gamble, New York City. Treas., H. L. Spencer. Supt. and Secy., Wm. Bowen.

OTTUMWA, *Wapello Co.* (Pop., 9,004; est., 14,000.) On Des Moines river which at this point falls 10 ft. in ½ mile, affording valuable water-power used in manufacturing. Settled '44; incorp. a village in '51, a city in '57, and reorganized in '68.

History.—Built in '77-8 by Iowa Water Co., under a 20 years' franchise. Des. Engr., S. L. Wiley, Omaha, Neb. Const. Engr., E. C. Cooke, Tiffin, O. Contr., Wiley Const. Co., Omaha, Neb.

Water Supply.—Des Moines river, water passing through a canal to a settling basin, thence through a filter to a pump-well, from which it is pumped to a reservoir. It is unofficially reported that the supply is unsatisfactory and that in '88 the company contracted with P. F. Kearnes to bore two wells, 1,100 and 1,500 ft. deep, 8 in. in diam. at the top and 5¾ in. at the bottom.

Canal and Settling Basin.—The canal is 40 ft. wide and 4,000 ft. long, and the settling basin 180 by 220 ft.

Filter.—Brick, 20 by 22 ft., containing several screens filled with animal charcoal. The cap. is said to be 3,000,000 galls. From the filter 400 ft. of 20-in. wrought iron pipe conveys water to the pump-well.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two Flanders' water-power pumps, and one Knowles pump; horizontal tubular boilers.

Reservoir.—Cap., 2,000 galls.; is 98 by 132 ft., and is 204 ft. above the city.

Distribution.—*Mains*, c. i., 15 miles. *Services*, w. i., lead. Pipe and specials furnished by Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and R. D. Wood & Co., Philadelphia, Pa. *Taps*, 582. *Meters*, 14. *Hydrants*, Holyoke, 100. *Valves*, Chapman.

Consumption, 1,500,000 galls. *Pressure*: 85 lbs.

Financial.—Hydrant rental, $75. All other data withheld.

Management.—Prest., W. A. Underwood. Supt. and Secy., W. McCue.

RED OAK, *Montgomery Co.* (Pop., 3,755; est., 4,000.) On Nishnabatona river on an undulating prairie. Settled in '64; incorp. a village in '68.

History.—Built in '80-1 by village. Engr. and Contr., P. B. Perkins, Springfield, Mass.

Water Supply.—Wells on bank of Nishnabatona river, connected by tunnels, by direct pumping. In case of fire water is taken from the river.

Pumping Machinery.—Dy. cap., 800,000 galls.; two Smith & Valle pumps of 16-in. steam, 8-in. water cylinders, and 18-in. stroke.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 200. ***Meters***, 11. *Hydrants*, kind not given, 46.

Consumption, 400,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 110 lbs.

Financial.—Cost, $32,000. Bonded debt, $23,500. Int., 5%. Ann. op. exp., $3,400. Ann. rev: consumers, $3,600; city, none.

Management.—Supt., R. Woodsworth. Report by O. P. Worsley.

REINBECK, *Grundy Co.* (Pop., 482; est., 900.)

History.—Built in '83 by village. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Well, pumping to tank. The well is 6 ft. in diam. for 20 ft., then a 3-in. pipe extends 43 ft. deeper.

Pumping Machinery.—Dy. cap., 20,000 galls.; driven by windmill.

Tank.—Cap., about 20,000 galls.; 20 ft. in diam. and 16 ft. high, on 20 ft. timber trestle. The bottom of the tank is about 80 ft. above the hydrants.

Distribution.—*Mains*, 8-in. Wyckoff wood, 2,000 ft. *Taps*, 2. *Hydrants*, 5.

Financial.—Cost, $3,800. Debt, $2,200. Int., 7%. Ann. op. exp., $75. No rev.

Management.—Not given. Report by J. B. Gillespie, who says the works "are an elephant on hands of city."

SAC CITY, *Sac Co.* (Pop., 595; est., 1,200.) On Coon river. Has water-power.

NOTE:—There are works here, owned by the town, but no description has been sent in answer to inquiries. City Clerk, J. W. Garrison.

SIOUX CITY, *Woodbury Co.* (Pop., 7,366; est., 30,000.) On Missouri river. Has extensive manufactories, trade and packing houses.

History.—Built in '83-4 by city. Des. Engr., W. C. Stripe, Keokuk. Const. Engr., —— Elliott. Contr. for masonry and buildings, E. W. Wakefield.

Water Supply.—Gang of driven wells, pumping to reservoir. The Missouri river was formerly drawn upon.

Pumping Machinery.—Holly pumps, dy. cap., 4,000,000 galls.

Reservoir.—Cap., 1,500,000 galls. Contrs., McRitchie & Nichol, Chicago, Ill.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by McRitchie & Nichol. *Taps*, 800. *Meters*, 50. *Hydrants*, Mathews, 110. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*; 100 lbs.

Financial.—Cost, $184,000. Debt, $30,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $13,712; city, none.

Management.—Chn. Com., J. S. Lynch. Secy., W. G. Linn. Supt., W. H. Barker. Pumping Engr., J. C. Duff.

STATE CENTRE, *Marshall Co.* (Pop., 880; est., 900.) On level plateau which forms the divide between Iowa and Skunk rivers. Settled in '59; incorp. a city in '69.

History.—Built in '79 by city. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Two wells, 58 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., 4,800 galls.; three deep-well pumps of 3-in. bore and 10½ in. stroke, driven by two windmills.

Tank.—Cap., 80,000 galls.; 24 ft. in diam. and 24 ft. high, on a 30-ft. timber trestle.

Distribution.—*Mains*, 6-in. c. i., 1 mile. *Services*, w. i. *Taps*, 9. *Meters*, none. *Hydrants*, Ludlow, 11.

Consumption, 1,500 galls. *Pressure*: 20 lbs.

Financial.—Cost, $10,000. Debt, $6,000. Ann. op. exp., $100. Ann. rev.: consumers, $25.

Management.—Supt., G. G. Bassett.

VINTON, *Benton Co.* (Pop., of township, 2,906; of village, est., 2,700.) On Red Cedar river. Has some manufactories.

History—Built in '88 and put in operation Jan. 1, '89, by town. Engrs., Loweth & Curtis, St. Paul, Minn. Contrs. for entire plant, except well, Denison & Cowell, Muscatine.

Water Supply.—Artesian well for domestic use and Cedar river for fire protection, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. compound condensing Gordon pumps.

Distribution.—*Mains*, 2.8 miles. Pipe and specials from Shickle Harrison & Howard Iron Co., St. Louis, Mo. *Meters*, none. *Hydrants*, Bourbon, 41. *Valves*, Bourbon.

Pressure: Ordinary, 40 lbs. Fire, 150 lbs.

Financial.—Cost, $29,000. Bonded debt, $19,000.

Management.—Chn. Finance Com., J. E. Maretta.

WATERLOO, *Black Hawk Co.* (Pop., 5,630; est., 7,000.) On Cedar river. Has various manufactories.

History.—Built in '86 by Waterloo Water-Works Co. under a 20 years' franchise. Engr., T. E. Cowell, of Denison & Cowell, Muscatine, who were the Contrs.

Water Supply.—Cedar river, by direct pumping.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Gordon & Maxwell compound pumps.

Distribution.—*Mains*, c. i., 9¾ miles. *Services*, w. i., lead. Pipe and specials furnished by Ohio Pipe Co., Columbus, O. *Taps*, 295. *Meters*, 3. *Hydrants*, Ludlow, 111. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $98,450. Capital stock, $125,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,150. Ann. rev.: consumers, $2,200; city, $4,000. Hydrant rental, $40 each for first 100, and $50 for additional.

Management.—Prest., G. B. Denison. Secy. and Treas., T. E. Cowell. Both of Muscatine. Supt. and Pumping Engr., J. J. Wall.

WEBSTER CITY, *Hamilton Co.* (Pop., 1,848; est., 3,200.) On Boon river in coal region.

History.—Built in '83 by village. Des. Engr., W. H. Burnham.

Water Supply.—Artesian well, pumping to tank and direct. Water was formerly taken from a well 8 ft. in diam. and 40 ft. deep.

Pumping Machinery.—Dy. cap., 100,000 galls.; double acting force pump of 5-in bore and 18-in. stroke, driven by a 25 ft. windmill, both furnished by the U. S. Wind Engine & Pump Co. In calm weather, and in case of fire, a Knowles steam pump is used; it has 14-in. steam and 7 in. water cylinders of 12-in. stroke.

Tank.—Cap., 58,000 galls.; wooden, 20 ft. in diam. and 30 ft. high, on a 30-ft. timber trestle, 70 ft. above business part of town.

Distribution.—*Mains*, c. i., 1 7-8 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Bailey, 15.

Consumption, 50,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 125 lbs.

Financial.—Cost, $20,000. Bonded debt, $13,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,000; city, none.

Management.—Comrs. Supt., S. E. La Barr.

WEST BURLINGTON, *Des Moines Co.* (Pop., est., 1,200.)

History.—Built in '87-8 by village. Engr., B. C. Pennington, West Burlington. Contr., Jno. Hult, Burlington, and F. L. Delfur, Carman, Ill.

Water Supply.—Reservoir of C. B. & Q. R. R. pumping to tank. Water passes through a meter.

Pumping Machinery and Tank.—Not described.

Distribution.—*Mains*, 6-in. c. i., 2,700 ft. *Meters*, one 6-in. *Hydrants*, Holly, 8.

Financial.—Cost, $4,000.

Management.—Chn. Water Board, B. C. Pennington. City Clerk, W. W. Clark.

WEST LIBERTY, *Muscatine Co.* (Pop., 1,141; est., 1,200.) Manufactures carriages, brick and tile.

General Description.—Built in '87-9 by town. Contr., A. K. Wellen, Morris, Ill. Water is taken from a flowing artesian well. *Mains*, 6-in. c. i., 1 mile. Cost, $5,000. Bonds, $7,500. Int., 6%. Town Clerk, T. K. Chase. No further data given.

Water-Works Projected with Fair Prospects of Construction.

CHEROKEE, *Cherokee Co.* (Pop., 1,523; est., 3,500.) On Little Sioux river.

Proposed System.—The city to put in works on the Holly plan at an estimated cost of $25,000. In Dec., '89, a vote was to be taken soon on a proposition to bond the town for works. Chn. Com., J. C. Hall.

CRESTON, *Union Co.* (Pop., 5,087; est., 8,000.) Has large stock yards and railway repair shops.

Proposed System.—A franchise has been granted to Comegys & Lewis, New York City. Water from springs and creek will probably be impounded in a reservoir and pumped thence to a tank. Est. cost, $200,000.

Present Supply.—Impounding reservoir of C. B. & Q. R. R., there being mains and 6 hydrants. City Clerk, A. M. Collins.

GLENWOOD, *Wills Co.* (Pop., 1,793; est., 2,000.) On Key creek. Engaged in manufacturing.

Proposed System.—A contract for an artesian well has been let to American Well Works Co., Aurora, Ill. The well will be finished Apr. 1, '89, and if a good supply is obtained a fire protection system will be built. If the natural head is not sufficient for a gravity supply water will be pumped to a tank. Report by Seth Dean, Glenwood, who has charge of the work.

LE MARS, *Plymouth Co.* (Pop., est., 5,000.)

Proposed System.—A private company to build works, taking supply from driven wells, by gravity. J. M. Dunn is at the head of the project.

MISSOURI VALLEY, *Harrison Co.* (Pop., 1,154; est., 3,500.)

Proposed System—To pump water from driven wells to a reservoir. Est. cost, $30,000. The town has voted a franchise to J. S. Wattles but it is stated that its provisions are so unfavorable that it is doubtful whether the works will be built. City Clerk, J. S. McGavren.

OSCEOLA, *Clarke Co.* (Pop., 1,769; est., 2,600.)

Proposed System.—In Nov., '89, an artesian well was down 1,600 ft.; the intention was to continue it to a depth of 3,000 ft. No further data given. Town Clerk, F. M. Kyte.

TIPTON, *Cedar Co.* (Pop., 1,299; est., 2,000.)

Proposed System.—An artesian well 2,700 ft. deep, with water 70 ft. from the surface, has been sunk. The town proposes to let contracts and build works in '89, pumping to reservoir at an estimated cost of $20,000. Bonds have been voted by the town. Engr., G. A. Mitchell. Report by the Mayor, A. Langhorn.

WILTON JUNCTION, *Muscatine Co.* (Pop., 1,431, est., 2,000.)

Proposed System.—To be built by Wilton Improvement Co. A flowing artesian well has been secured. Address W. G. Johnson or J. Donavin.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Allison, *Butler Co.*; Carson, *Pottawattamie Co.*; Centerville, *Appanoose Co.*; Dunlap, *Harrison* Co.; Silver city, *Mills Co.*; Washington, *Washington Co.*; What Cheer, *Keokuk Co.*

MINNESOTA.

Water-Works Completed or in Process of Construction.

AUSTIN, *Mower Co.* (Pop., 2,305; est., 4,500.) On Cedar river. Has machine shops and canning factory.

History.—Built in '87 and put in operation Jan., '88, by town. Engr., Chas. F. Loweth, St. Paul. Contrs., National Iron & Brass Works, Dubuque, Ia.

Water Supply.—Artesian well for domestic, and Cedar river for fire purposes, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound condensing Smedley pumps, made by Contrs.

Distribution.—*Mains*, 10 to 4-in. c. i. *Services*, lead. Pipe from Detroit (Mich.) Pipe Works, and Lake Shore Foundry, Cleveland, O. *Taps*, 13. *Meters*, none. *Hydrants*, Mathews, 52. *Valves*, Galvin.

Consumption, 14,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $40,000. Bonded debt, $30,000. Int., 6 and 7%. Ann. op. exp. and rev. not determined at time of report.

Management.—Supt., J. M. Greenman.

BRAINERD, *Crow Wing Co.* (Pop., 2,319; est., 10,000.) On Mississippi river. Engaged in manufacturing and commerce.

History.—Built in '83 by Brainerd Water Co.

Water Supply.—Mississippi river, by direct pumping.

Pumping Machinery.—A 2,000,000-gall. duplex condensing Blake pump, with 18-in. steam and 10-in. water cylinders of 12-in. stroke.

Distribution.—*Mains*, c. i., Kalamein i., 13 miles. *Services*, galv. i. *Taps*, 525. *Meters*, not given. *Hydrants*, Ludlow, 75. *Valves*, Ludlow.

Consumption, 600,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $110,000. Debt, $100,000. Int., 6%. Ann. op. exp., $7,900. Ann. rev.: consumers, $8,000; city, $5,070. Hydrant rental, $75.

Management.—Prest., C. F. Kindred. Secy. and Treas., O. H. Havill.

CANNON FALLS, *Goodhue Co.* (Pop., 942; est., 1,200.) On Cannon river, which affords water-power used in manufacturing.

History.—Built in '87-8 by village. Des. Engr., J. W. Potter. Const. Engr., Gus Oberg.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—A small pump made by H. Chalgreen, Cannon Falls, and driven by a windmill.

Reservoir.—Cap., about 175,000 galls.; 22 by 55 ft., by 12 ft. deep, and 152 ft. above town.

Distribution.—*Mains*, 8-in. c. i., 1,500 ft. *Taps*, 15. *Meters*, none. *Hydrants*, Galvin, 2.

Pressure: 75 lbs.

Financial.—Cost, $5,500. Bonded debt, $5,000. Int., 6%.

Management.—Village Prest., F. B. Seager. Recorder, J. A. Wilson.

CROOKSTON, *Polk Co.* (Pop., 1,227; est., 6,000.) On Red Lake river on rolling land, in lumber region. Settled in '72; incorp. a city in '79.

History.—Built in '82 by Crookston Water-Works, Power & Light Co., under a 30 years' franchise. Const. Engr., W. D. Hurlburt. Des. Engr. of later work, K. D. Chase, with D. Jacobus as Const. Engr. Labor done by company.

Water Supply.—Red Lake river, by direct pumping. The river rises 75 miles east of the city, in Red lake, and has a drainage area of 52¾ sq. m.

Dam.—Across river, size not given. Piles were driven in the river, which has a blue clay bottom, and filled between with brush, boulders, gravel and earth, the piles being capped and planked over.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington steam pump, and a water-power pump designed by Jas. Waters and built by the Pray Mfg. Co.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i., lead. *Taps*, 125. *Meters*, 1. *Hydrants*, Ludlow, 41. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $150,000. Bonded debt, $105,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $9,000; city, $4,000. Hydrant rental, $100.

Management.—Prest., D. Jacobus. Treas., W. N. Ross. Secy., A. B. Goryas. Supt., D. Jacobus.

DULUTH, *St. Louis Co.* (Pop., 3,483; est., 3,500.) At head of Lake Superior and at mouth of St. Louis river, on undulating ground. Engaged in commerce, lumbering, mining and manufacturing. Settled and incorp. a city in '68.

History.—Built in '83 by Duluth Gas & Water Co., under a 30 years' franchise. Des. Engr., Carroll E. Gray. Const. Engr., R. P. Corbyn. Later work has been done with R. B. C. Bement as Des., and Wm. Craig, Const. Engr. Quite extensive improvements were made in '88.

Water Supply.—Lake Superior, pumping to reservoir.

Intake.—A pipe was first laid into the lake in a trunk, or box, sunk in the granite bottom, the pipe ending at a crib in 40 ft. of water. The pipe was extended further out in '88.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000-gall. Blake, and 3,000,000-gall. compound duplex pumps. Tubular boilers.

Reservoir.—Cap., 604,969 galls.; 40 by 80 ft., by 20 ft. deep, and 265 ft. above the pumps. Built of granite masonry, with inner walls vertical. Enclosed to make it frost-proof. A new reservoir, 285 ft. above the pumps, was proposed for 88; it is not stated whether this was built.

Distribution.—*Mains*, c. i., w. i., Kalamein i., 25 miles. *Services*, lead. *Taps*, 700. *Meters*, 28. *Hydrants*, Ludlow, 107. *Valves*, Ludlow.

Consumption, 1,000,000 galls. *Pressure*; 20 to 90 lbs.

Financial.—Cost, $587,000. Capital stock, $500,000. Bonded debt, $282,000. Int., 6%. Ann. op. exp., $36,000. Ann. rev.: total, $45,000. Hydrant rental, first 80, $100 each; next 50 at $80, and additional for $60 each.

Management.—Prest., Geo. Spencer. V. Prest., S. M. Carey. Treas., R. B. C. Bement. Secy., Geo. C. Squires. Supt., Wm. Craig.

FARIBAULT, *Rice Co.* (Pop., 5,415; est., 7,000.) At junction of Cannon and Straight rivers, on low ground with hills rising from the valley from 100 to 200 ft. Settled in '53; incorp. a city in '56.

History.—Built in '83-4 by Faribault Water Works Co., under a 25 years' franchise. Engrs., G. E. Beach and A. C. Miller, Minneapolis. The former was the Contr.

Water Supply.—Surface wells, pumping to reservoir. The first well is 20 ft. in diam. and 19 ft. deep, sunk through gravel to sandstone. The second well was sunk later, and is 30 ft. in diam.

Pumping Machinery—Dy. cap., 1,000,000 galls.; high and low-pressure duplex condensing Deane pumps, and tubular boilers.

Reservoir.—Cap., 750,000 galls.; roofed, 80 ft. in diam., 23 ft. deep, 219 ft. above the city and 235 ft. above the pumps.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i., lead. *Taps*, 106. *Meters*, 8. *Hydrants*, Chapman, 59. *Valves*, Chapman.

Consumption, 100,855 galls. *Pressure*: 96 lbs.

Financial.—Cost, $140,000. Debt, $80,000. Int., 6%. Ann. op. exp., $2,800. Ann. rev.: consumers, $3,000; city, $5,010. Hydrant rental, $80.

Management.—Prest., A. T. Rand. Secy., W. H. Getchell. Supt., A. C. Miller.

FERGUS FALLS, *Otter Tail Co.* (Pop., 1,635; est., 6,000.) On rolling prairie land on Red river of the North, which falls 200 ft. in four miles, furnishing water-power used in manufacturing. Settled in '70; incorp. a city in '81.

History.—Built in '83 by Fergus Falls Water Co., under a 30 years' franchise. Engr. and Contr., Carroll E. Gray, Chicago, Ill.

Water Supply.—Red river of the North, by direct pumping.

Dam.—Size not given. Of timber and stone built across river two miles above main portion of city to store water for supply and for motive power.

Conduit.—Conveys water from dam to pumps under a 12-ft. head. Diam., 8 ft.

Pumping Machinery.—Dy cap., 4,250,000 galls.: two 1,500,000-gall. duplex water-power pumps, and one 1,250,000-gall. Worthington steam pump.

Distribution.—*Mains*, Kalamein i., 8 miles. *Services*, lead, Kalamein i. *Taps*, 258. *Meters*, none. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 55 lbs. Fire 100 lbs.

Financial—Cost, $142,000. Capital stock, $82,000. Bonded debt, $88,000. Int., 6%. Ann. op. exp., withheld, but est., $3,000. Ann. rev.: consumers, withheld, but est., $5,000; city, $6,000. Hydrant rental, $80 each for 50, and $70 for additional.

Management.—Prest., Carroll E. Gray, Chicago, Ill. Secy., F. W. Burnham. Treas., C. D. Wright. Supt., Theo. W. Gray.

FORT SNELLING, *Hennepin Co.* (Pop., est., 350.) On and about 100 ft. above Mississippi river. Established as a military post by the U. S. Government in '20.

History.—Built in '82 by U. S. Government. Des. Engr., Capt., Edw. Maguire, U.S. Corps of Engrs.

Water Supply.—Spring, pumping to tank and direct.

Dam.—Of stone, 5 ft. high, 2½ ft. thick, coated on both sides with Weem's patent stone. Impounds spring water.

Pumping Machinery.—Cap. not given. Blake pump with 16-in. steam and 8-in. water cylinders of 16-in. stoke.

Tank.—Cap., 30,000 galls.; 56 ft. above pump.

Distribution.—*Mains*, c. i., 2 miles. *Services*, lead. *Taps*, 35. *Meters*, none. *Hydrants*, Mathews, 20. *Valves*, Chapman.

Consumption, 40,000 galls. *Pressure*: Ordinary, 25 lbs.

Financial.—Cost and op. exp., not given. No debt or rev.

Management.—Post Quartermaster.

GLENWOOD, *Pope Co.* (Pop., 464; est., 500.) On Lake Whipple.

History.—Built in '83 by village.

Water Supply.—Spring creek, by gravity from impounding reservoir.

Dam and Reservoir.—Cap., 150,000 galls. Dam consists of wooden cribs filled with stone, planked on the upper side and backed with earth. Reservoir is about 40 by 100 ft., by 10 ft. deep.

Distribution.—*Mains*, w. i., 1.6 miles. *Services*, galv. i. *Taps*, 26. *Meters*, none. *Hydrants*, Ludlow.

Consumption, not given. *Pressure*: 60 lbs.

Financial.—Cost, $7,000. Debt, $4,000. Int., 10%. Ann. op. exp., $500. Ann. rev.: consumers, $160.

Management.—Water Warden. Report by K. J. Kinney.

LANESBORO, *Fillmore Co.* (Pop., 1,032; est., 1,200.)

History.—Built for fire protection in '85-6 by village.

Water Supply.—Well 200 ft. deep, pumping to reservoir.

Pumping Machinery.—Dy. cap., 35,000 galls.; driven by windmill.

Reservoir.—Cap., 225,000 galls.; about 130 ft. above town.

Distribution.—*Mains*, 8-in. c. i., ½ mile. *Hydrants*, 6.

Pressure: 60 lbs.

Financial.—Cost, $10,000. Bonded debt, $5,000. Int., 7%. Ann. op. exp., $200. No rev.

Management.—Secy., Jno. Johnson. Chf. Fire Co., B. A. Man.

MANKATO, *Blue Earth Co.* (Pop., 5,550; est., 10,000.) At junction of Minnesota and Blue Earth rivers. The business part of the city is 30 ft. above the river, and back of this bluffs rise.

History.—Built in '79 by city. Des. Engr., M. B. Haynes, then City Engr. Contrs., R. D. Hubbard & Co. The supply thus far has been used only for fire protection, the water being impure. A new system, taking water from artesian wells has been proposed.

Water Supply.—Minnesota river, pumping to reservoir, which was completed in '88. Previous to this direct pumping was used. Sewage discharges into the river.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Knowles pump of 12-in. bore and 24-in. stroke.

Reservoir.—Contr., Adam Jefferson, Mankato.

Distribution.—*Mains*, c. i., 3½ miles. *Hydrants*, Mathews.

Pressure: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $28,000. Debt, not given. Ann. op. exp., $2,500. No rev.

Management.—City Engr., E. Lilly. Report by C. A. Chapman.

MINNEAPOLIS, *Hennepin Co.* (Pop., 46,887; est., 160,000.) On Mississippi river at St. Anthony's Falls. Has extensive water-power. The city is on a broad elevated plain. Settled in '49; incorp. a city in '67.

History.—Built in '67 by city. Engr., Jas. Waters, who was connected with the works for several years. The site of the pumping station was changed in '72, and the works enlarged. In '88 extensive improvements were made, including a new and large pumping plant.

Water Supply.—Mississippi river, by direct pumping.

Pumping Machinery.—Dy. cap., 72,750,000 galls., of which 42,750,000 galls. is by the water-power pump. The first pump was a 2,000,000-gall. Holly rotary, which was used until the present old station was established in '72.

There are seven pumps at the two old stations, all designed by Jas. Waters and driven by water-power, but with two steam engines as auxiliary for driving the first two pumps. No. 1 began duty in '72; it was built by C. M. Hardenburgh, Minneapolis. It is a double-acting piston pump, with upright vertical cylinders of 9-in. bore and stroke, and making 60 revolutions a minute. Cap., 2,250,000 galls. No. 2 was put in operation in '75. It was built by Jas. Waters, and is a horizontal double-acting piston pump of 16-in. bore and 24-in. stroke, making 30 revolutions a minute. Cap., 3,500,000 galls. Nos. 3 and 4 are similar to No. 2, and were built by the Pray Mfg. Co., Minneapolis. Nos. 5, 6 and 7 consist of gangs of five single-acting plunger pumps, 13½ in. in diam. and with 24-in. stroke. At 95 revolutions a minute each has a cap. of 10,000,000 galls.; and the three were built by Strotham Bros., Minneapolis. The last three pumps began duty in '83, '84 and '85, respectively. The first six pumps are at the West Side station, and No. 7 at the East Side station, on Hennepin island.

A pair of 54-in. turbine water wheels drives pumps Nos. 1 and 2, and can also be used to drive No. 3. A 60 in turbine drives No. 4, and also No. 3 when not driven by the above turbines. There is an independent 60-in. turbine, each, for pumps Nos. 5 and 6, and No. 7 has a 75 in. turbine. All are American turbines.

The two engines for use in low water are Parish, condensing, high-pressure, with 20-in. cylinders of 24-in. stroke. There are six 5 by 16-ft. boilers. Engines and boilers were built by the North Star Iron Works, having been designed by M. Parish, of that firm.

A new pumping station was built on Shingle creek, near the Mississippi river, in '88. There are two 15,000,0000-gall. horizontal compound Worthington pumps having a piston speed of 125 ft. a minute. Horizontal tubular boilers are used. A 36 in. cast-iron main, 12,000 ft. long was laid from this pump-house to the city.

Submerged Pipe.—Across Minnesota river. In the spring of '80 a flood washed the sand from under the pipe for 100 ft., causing the pipe to pull apart, and cutting off water from the east side for six weeks. At this time the broken pipe was covered by a deposit of 7 ft. of mud. It was relaid on bed-rock.

Distribution.—*Mains*, c. i., 112 miles. *Services*, w. i. *Taps*, 5,598. *Meters*, 228. *Hydrants*, Mathews, Waters, Lowry flush, 1,410. Hydrants for filling sprinkling carts, 171. *Valves*, Eddy.

Consumption, 10,814,005 galls. *Pressure*: 80 lbs.

Financial.—Cost. $1,422,376. Debt, $945,000. Int., 4½%. Ann. op. exp., $68,000. Ann. rev.: consumers, $137,178; city, none.

Management.—City Engr., Andrew Rinker. Supervisor, Matt. Walsh. Registrar, F. T. Moody. Asst. Engr., Wm. W. Redfield.

MOORHEAD, *Clay Co.* (Pop., 1,700; est., 2,500.) On Red river of the North.

History.—Built in '81 by village. Des. Engr., U. B. Hough. No Const. Engr.

Water Supply.—Red river of the North, by direct pumping. Artesian wells are being sunk.

Pumping Machinery.—Blake pumps, dy cap., not given.

Distribution.—*Mains*, 10 to 4-in. c. i., 6 miles. *Services*, w. i. *Taps*, 120. *Meters*, 26. *Hydrants*, kind not given, 75.

Consumption, not given. *Pressure*: Ordinary, 30 lbs. Fire, 100 lbs.

Financial.—Cost, $35,000. Debt, $10,000. Int., 7%. Ann. op. exp., $4,000. Ann. rev.: consumers, $3,500.

Management.—Water Com. City Attorney, C. A. Nye.

PIPE STONE, *Pipe Stone Co.* (Pop., 222; est., 1,500.)

History.—Built in '88 by village. Engr., Edwin Smedley. Contrs., National Iron & Brass Works, Dubuque, Ia.

Water Supply.—Bored well, 6 in. in diam. and 200 ft. deep, pumping to standpipe.

Pumping Machinery.—Cap., not given; deep-well pump of 3½ in. in diam. and 18-in. stroke, driven by a 25-ft. Halliday windmill.

Stand-Pipe.—Cap., about 90,000 galls; 12½ ft. in diam. and 100 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 8 to 4-in. c. i., 2 miles. *Taps*, 3. *Hydrants*, Chapman, 10. *Pressure*: 40 to 43 lbs.

Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $500. Ann. rev.: consumers, $500.

Management.—Chn. Water Board, C. C. Goodnow.

RED WING, *Goodhue Co.* (Pop., 5,876; est., 7,000.) On Mississippi river. Has manufactories.

History.—Built in '84 by city. Des. Engrs., H. B. Wilson and H. H. Harrison. Const. Engr., G. E. Beach, Minneapolis.

Water Supply.—Mississippi river, filtered, pumping to reservoir.

Filters and Conduit.—Water passes from the river to and through two wells, in the first of which are screens and in the second sponges. A 14-in. conduit, 800 ft. long, extends from the filters to the pump-well.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; duplex non-condensing Blake ump of 20 in. steam and 18-in. water cylinder and 24-in. stroke.

Reservoir.—Cap., 1,000,000 galls.; 18 by 400 ft., by 20 ft. deep, and is 235 ft. above the pumps and 210 ft. above the city. Excavated in the side of a rock bluff, and lined with brick in cement.

Distribution.—*Mains*, c. i., 7.2 miles. *Services*, Kalamein i. *Taps*, 145. *Meters*, 32. *Hydrants*, kind not given, 61.

Consumption, about 80,000 galls. *Pressure*: 108 lbs.

Financial.—Cost, about $82,000. Debt, $80,000. Int., 5%. Ann. op. exp., $4,386. Ann. rev.: consumers, $3,139.

Management.—Secy., S. J. Willard. Supt., W. A. Potter.

ROCHESTER, *Olmstead Co.* (Pop., 5,103; est., 7,500.)

History.—Built in '87 by Rochester Water-Works Co., under a 30 years' franchise. Controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y., who were the Contrs. Engr. for preliminary work, Robt. E. Williams, deceased. Des. Engr., F. S. Pecke, Watertown, N. Y. Supt. of Construction, Wm. Walter, Phœnix, N. Y.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., 2,000,000 galls.

Stand-Pipe.—Cap., 225,000 galls.; 25 ft. in diam. and 62 ft. high. Made by Riter & Conley, Pittsburg, Pa.

Distribution.—*Mains*, 14 to 4-in. c. i., 9½ miles. *Services*, galv. i. *Taps*, 45. *Meters*, none. *Hydrants*, Ludlow, 132. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*: Ordinary, 79 lbs. Fire, 150 lbs.

Financial.—Cost, $150,000. Debt, $115,000. Int., 6%. Ann. op. exp., withheld, but est., $3,500. Ann. rev.: consumers, withheld, but est., $5,000; city, $4,282.50 for 132 hydrants, or about $30 each.

Management.—Prest., J. F. Moffett. Secy., J. V. Clarke. Both of Watertown, N. Y. Supt., C. W. Streator.

SAINT CLOUD, *Stearns Co.* (Pop., 2,462; est., 10,000.) On Mississippi river in agricultural and lumber district.

History.—Built in '83 by city, and bought in '87 by St. Cloud Water-Works Co. Engrs. for original works, Pike & Sturtevant. Contrs., V. D. Simar & Co. Important extensions were made in '88 with E. T. Abbott, Minneapolis, as Engr. Day labor was employed.

Water Supply.—Mississippi river, pumping to stand-pipe and direct.

Intake Pipe and Crib.—The pipe is 16 in. in diam. and in '88 it was extended 747 ft. and a new crib built. This was done in March, when the river was covered with 28 in. of ice, and the water 10 ft. deep. The pipe for the extension was wrought-iron, in lengths of 28¾ ft., and was riveted on the ice. Piles were driven along the line of pipe, 25 ft. apart, and timbers spiked to them at right angles. Through the latter 7-16 in. rods with a 10-ft. thread at the upper end were run down vertically, and bent around the pipe. There were 24 rods, and by turning each nut upwards the pipe was lowered throughout its entire length. The pipe now rests against the upstream side of the piles, which have been sawed off close to the upper side of the pipe. The pipe was furnished by Peter Devlin & Sons, Chicago, Ill.

The intake crib was sunk in a similar way, and with the pipe. It rests on nine piles, sawed off at the bed of the river. The crib is 6 ft. sq. by 4 ft. high, has a floor composed of five layers of 2-in. plank, and sides formed by screens of ⅜-in. iron with 3-in. meshes. The top is of 1 by 1½-in. iron, with 5 in. meshes, and is loaded with 80 cu. yds. of small stone.

Pump-Well.—Is 4 by 14 ft., and 5 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls; two 500,000-gall. Holly-Gaskill pumps and one 2,000,000-gall. Deane.

Stand-Pipe.—Cap., 350,000 galls.; 25 ft. in diam. by 100 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. Pipe and specials furnished by Shickle, Harrison & Howard Iron Co. *Taps*, 120. *Meters*, 4. *Hydrants*, Coffin. *Valves*, Coffin.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 110 lbs.

Financial.—Cost, $175,000. Capital stock, $150,000. Bonded debt, $130,000. Int., 6%. Ann. op. exp., withheld, but est., $4,000. Ann. rev.: consumers, $4,000; city, $6,150. Hydrant rental, $60 each for 100, and $50 for each additional.

Management.—Prest., H. W. Phelps. Secy., E. T. Sykes. Both of Minneapolis.

SAINT PAUL, *Ramsey Co.* (Pop., 41,473; est., 200,000.) On Mississippi river. The bottom lands, submerged in extreme high water, are about ¾ mile wide. They end at a bluff of limestone, underlaid with sandstone, which rises abruptly 100 ft. to a terrace ½ mile wide. Back of the latter is a range of drift hills which rises 250 ft. above the river. At the eastern end of the city Phalen's creek enters the river through a ravine. Settled in '38; incorp. a town in '49; a city in '54.

History.—Built in '70 by a private company, and bought by the city since '82 for $510,000. Important extensions were made in '88.

Water Supply.—Phalen, Vadnais, Pleasant and others of a chain of lakes, by gravity, and by direct pumping for high service. There is a chain of 19 lakes, connected by natural and artificial channels; 9 of these lakes, at least, are available for the city's supply. They have a combined area of 2,436 acres, and from 1 to 4 ft. of water can be drawn from them.

Old Conduit.—The first supply was by gravity from Phalen's lake, two pipes extending 300 ft. into it to 15 ft. of water. From the shore a 24-in. stoneware and a 16-in. cement pipe conveyed water for 7,000 ft., when they united in a 16-in. wrought iron and cement pipe, 15,700 ft. long, leading to the city.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two pumps, make not given.

Reservoir.—Cap., 16,000,000 galls. Built to equalize pressure, and for economy in pumping, the inlet and outlet pipe being one and the same, and water passing from the pump to the reservoir when the consumption is less than the pumpage, and from the reservoir to the city mains when the pumpage is less than the consumption.

At the water line the reservoir is 300 by 500 ft., and it is 20 ft. deep. The sides are straight and the ends semicircular. The embankments are 90 ft. thick at the base, with inner and outer slopes of 1½ to 1, and a parapet 12 ft. wide The basin is of concrete, and the inner slopes are faced with granite. The inlet and outlet pipe is at the bottom, 36 in. in diam.

The water for this reservoir originally comes from Lake Vadnais through a 4-mile conduit which terminates in a chamber at the pumps.

The reservoir cost about $150,000. Engrs., J. T. Fanning, Minneapolis, and H. H Harrison, Stillwater. Const. Engr., J. B. Hawley, who is Engr. to the Water Board Contrs., McArthur Bros., St. Paul.

Submerged Pipe.—A 16-in. pipe was laid across the river in '87 with McRitchie & Nichol, Chicago, Ill., as Contrs.

Distribution.—*Mains*, c. i., w. i., and cement, 104 miles. *Services*, lead. Pipe and specials furnished, of late, by Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 6,017. *Meters*, 249. *Hydrants*, Mathews, Ludlow, Whittier, Galvin, Holly, 868. *Valves*, Eddy, Ludlow, Galvin, Whittier.

Consumption, not given. *Pressure*: 45 lbs.

Financial.—Cost, $1,966,275. Bonded debt, $1,860,000: $1,310,000 at 5, $200,000 at 4½ and $350,000 at 4%. The city assumed the 8% bonds of the Water Co. to the amount $160,000 when it purchased the works. Ann. op. exp., $27,063. Ann. rev., consumers $166,496; city, $41,600, being $400 for each mile of mains.

Management.—Prest. of Comrs., J. F. Hoyt. Secy., Jno. Caulfield. Supt., Jno. B. Overton. Pumping Engr., Martin Feist.

SAUK CENTRE, *Stearns Co.* (Pop., 1,201; est., 3,000.) On Sauk river, which affords water-power used in manufacturing.

History.—Built in '84 by a private company, which has failed since. The town and company are in litigation, and meanwhile the town operates the works. Engr. S. D. Savier.

Water Supply.—Sauk lake, by direct pumping.

Pumping Machinery.—Dy. cap., 400,000 galls.; Worthington water-power pumps.

Distribution.—*Mains*, w. i., 1½ miles. *Services*, galv. i. *Taps*, 52. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 25,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 110 lbs.

Financial.—Cost, $14,000. Bonded debt, $14,000. Int., 7%. Ann. op. exp., $1,600. Ann. rev.: consumers, $1,575; city, $1,125. Hydrant rental, $75.

Management.—Supt., L. E. Coe.

STILLWATER, *Washington Co.* (Pop., 9,055; est., 18,000.) At head of Lake St. Croix, on a small plain surrounded with hills which rise to an elevation of about

280 ft. above the valley. Engaged in manufacturing. Settled in '42; incorp. a city in '54.

History.—Built in '80 by Stillwater Water Co. under a 30 years' franchise. Des. Engr. of pumping machinery, H.H. Harrison. Const. Engr., Walter H.Sears. Contrs., Fruin & Co., St. Louis, Mo.

Water Supply.—McKusick's lake, by gravity for low, and by pumping to tanks for high service. The lake is about one mile from and 150 ft. above the city, covers 65 acres, is from 6 to 10 ft. deep, and has a drainage area of about 6 sq. m.

Filter.—Is 50 by 100 ft., by 10 ft. deep, with gravel and charcoal placed upon 2 by 4-in. plank on edge with spaces between. From the filter proper water passes to a clear water reservoir 100 by 200 ft., by 10 ft. deep, from which water passes directly to the city and to the pumps.

Pump Well.—Is 6 by 12 ft., by 12 ft. deep.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Blake pumps with 20-in. steam and 11-in. water cylinders of 24-in. stroke.

Tanks.—Cap., 100,000 galls. each.; 30 ft. in diam. and 20 ft. high, located on hills in different parts of the city.

Distribution.—*Mains*, c. i., 9.4 miles. *Services*, galv. i. *Taps*, 425. *Meters*, 2. *Hydrants*, Ludlow, 88. *Valves*, Ludlow.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 to 90 lbs.

Financial.—Cost, $200,000. Bonded debt, $100,000. Int., 7%. Ann. op. exp., $4,000. Ann. rev.: consumers, $10,000; city, $7,200. Hydrant rental, about $80.

Management.—Prest., E. W. Durant. V. Prest., R. F. Hersey. Treas., R. S. Davis. Gen. Mgr. and Secy., H. H. Harrison.

WINONA, *Winona Co.* (Pop., 10,208; est., 25,000.) On Mississippi river, from 12 to 15 ft. above it, surrounded by bluffs. Has general manufactories.

History.—Built in '76 by city. Des. Engr. and Contr., Geo. C. Morgan, Chicago. Sub-contr. for masonry and buildings, Munch & Locke, Winona.

Water Supply.—Two wells near Mississippi river, each 38 ft. in diam. and 50 ft. deep, pumping to stand-pipe. The second well was sunk in '88. When the works were built two wells, 10 and 16 ft. in diam., and a mile apart, were drawn upon, there being a pump for each in mill, a Blake and a Knowles.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; 2,000,000-gall. compound condensing low, and 3,000,000-gall. compound duplex high-pressure Worthington pump. The latter is used only in case of fire or emergency.

Stand-Pipe.—Is 4 ft. in diam. and 225 ft. high.

Distribution—*Mains*, c. i., 16 miles. *Services*, w. i., galv. i. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 1,000. *Meters*, none. *Hydrants*, kind not given, 175.

Consumption, 1,184,634 galls. *Pressure*: Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $200,000. Debt, $100,000. Int., 4½%. Ann. op. exp., $14,000. Ann. rev.: consumers, $8,000.

Management.—Comr., Jno. B. Fellows. Supt., B. V. Simpson.

Water-Works Projected with Fair Prospects of Construction.

ORTONVILLE, *Big Stone Co.* (Pop., 709; est., 1,000.) On Minnesota river.

Proposed System.—Village to build works, pumping from Big Stone lake to a tank. Est. cost, $10,000. The last of Dec., '88, the village had voted $6,000 of bonds, and when $4,000 more are voted construction will be begun. H. H. Harrison, Stillwater, is the Engr. Report by W. C. Whiteman.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Albert Lea, *Freeborn Co.*; Anoka, *Anoka Co.*; Benson, *Swift Co.*; Hayward, *Freeborn Co.*; Owatonna, *Steele Co.*; Sauk Rapids, *Benton Co.*; Waseca, *Waseca Co.*

KANSAS.

Water-Works Completed or in Process of Construction.

ABILENE, *Dickinson Co.* (Pop., 2,360; est., 8,000.) On Smoky Hill river on level ground. Railway and manufacturing center. Settled in '68.

History.—Built in '82 by Abilene Water & Electric Light Co. Des. Engr., C. Orton.

Water Supply.—Well, 20 ft. in diam. and 40 ft. deep, by direct pumping.

Pumping Machinery.—Holly-Gaskill pump, dy, cap., 1,250,000 galls.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i., lead. *Taps*, 325. *Meters*, 14. *Hydrants*, Holly, 68. *Valves*, Holly.

Consumption, 700,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 80 lbs.

Financial.—Cost, $120,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $1,800. Ann. rev.: consumers, $6,000; city, $5,725. Hydrant rental, $100 each for 50, and $75 for additional.

Management.—Prest., J. E. Bonebrake. Supt. and Secy., R. M. Whit.

ANTHONY, *Harper Co.* (Pop., 345; est., 2,000.)

General Description.—Built in '87 or '88. Water is pumped to a 150,000-gall. stand-pipe. There are 4½ miles of mains and 50 hydrants. Town Clerk, Jas. Smith. No other data can be obtained.

ARKANSAS CITY, *Cowley Co.* (Pop., 1,012; est., 8,000.) At junction of Walnut and Arkansas rivers. Has water-power.

History.—Built in '86 by Arkansas City Water Co.

Water Supply.—Arkansas river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two compound duplex Blake pumps, and two 60 H. P. steel boilers.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i., lead. *Taps*, 300. *Meters*, 5. *Hydrants*, Chapman, Bourbon, 150.

Consumption, 175,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $150,000. Capital stock, $150,000. No debt. Ann. op. exp., withheld, but est., $6,000. Ann. rev.: consumers, withheld, but est., $8,000; city, about $9,000. Hydrant rental, $60.

Management.—Prest., J. B. Quigley, St. Louis. Secy., L. P. Andrews. Supt., M. L. Andrews.

ARMOURDALE, *Wyandotte Co.* See Kansas City, Mo.

ARMSTRONG, *Waandotte Co.* See Kansas City, Mo.

ATCHISON, *Atchison Co.* (Pop., 15,105; est., 25,000.) On Missouri river in the valley of White Clay creek. The elevation varies from 38 to 180 ft. above low water in the river. An important railroad center, also having manufactories. Settled in '54; incorp. a city in '58.

History.—Built in '80 by Atchison Water Co. Des. Engr., Thos. J. Whitman.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two upright direct-acting plunger Cope & Maxwell pumps, with 24-in. steam and 14-in. water cylinders of 36-in. stroke. The pumps are about 16 ft. above low water, and the river rises 27 ft.

Reservoir.—Cap., 4,000,000 galls.; in two divisions, one of which is used as a settling basin. This basin is 50 by 145 ft. at the bottom, 100 by 185 at the top, 13 ft. deep, and 224 ft. above the pumps.

Its bottom and sides are puddled, then covered with 4 in. of broken stone, on which is a pavement of brick on edge in cement. The bottom slopes toward the center and the south end, where a 12-in. outlet pipe allows the sediment to be discharged.

When the river is frozen water can be used without settling, but at other times it stands from 8 to 12 hours in the settling, before being drawn to the clear water basin, which is 75 by 160 ft. at the bottom, 145 by 220 ft. at the top, 20 ft. deep, and has its water line 1 ft. lower than that of the other basin.

Supply Main.—From reservoir to city, formerly 400 ft. of 12-in. cast-iron pipe. It is not stated whether this is still in use.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i., lead. *Taps*, 800. *Meters* 42. *Hydrants*, White, 82. *Valves*, Peet.

Consumption, 500,000 galls. *Pressure*; Ordinary, 70 lbs.

Financial.—*All data withheld, but the following estimates are made.* Cost, $150,000. Ann. op. exp., $7,000. Ann. rev.: consumers, $20,000; city, $8,000.

Management.—Prest., Jn R. Lionberger. Secy., Jno. D. Davis, St. Louis, Mo. Supt., E. S. Wills.

BELOIT, *Mitchell Co.* (Pop., 1,835; est., 4,000.) On Solomon river. Has water-power.

History.—Built in '87 by city and afterwards sold to E. E. Stevens & Co., Larned, for $27,000, granting him 21 a years' franchise. Des. Engr., J. S. Stevens. Labor done by company.

Water Supply.—Wells on bank of Solomon river, pumping to tank.

Pumping Machinery.—Dy. cap., not given.; Worthington pump.

Tank.—Iron, 32 by 20 ft., on 70 ft. masonry tower.

Distribution.—*Mains*, 10 to 4-in. c. i., 5⅝ miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard, St. Louis, Mo. *Meters*, 1. *Hydrants*, Nelson, 35. *Valves*, Peet.

Financial.—Cost, not given, but est., $60,000. Capital stock, $100,000. Bonded debt, $54,000. Int., 6%. Hydrant rental, $47.

Management.—Prest. and Supt., E. E. Stevens. Secy. and Treas., W. S. Peck.

NOTE:—Further data not given.

BIRD CITY, *Cheyenne Co.* (Pop., est., 300.)

History.—Built in '87-8 by village. Engr. and Contr., Jos. Burns, Lincoln, Neb.

Water Supply.—Four 3-in. tube wells, about 240 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 60,000 galls.; four vertical pumps driven by 20 H. P. boiler.

Tank.—Cap., about 35,000 galls.

Distribution.—*Mains*, 3 and 2-in. w. i., 1½ miles. *Hydrants*, 4.

Financial.—Cost, $6,500. Bonded debt, $5,000. Int., 10%.

Management.—Chn. Com., Jno. Elliott. Report by J. H. Humlong.

BUNKER HILL, *Russell Co.* (Pop., 135; est., 400.)

History.—Built in '86 by Bunker Hill Water Co., under a 20 years' franchise. Contrs., N. O. Nelson Mfg. Co., St. Louis, Mo.

Water Supply.—Springs, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 30,000 galls.; pump made by —— Hopkins, Dubuque, Ia.

Tank.—Cap., about 60,000 galls.; 26 ft. in diam. and 16 ft. high.

Distribution.—*Mains*, 2½-in. w. i., 3.7 miles. *Services*, galv. i. *Taps*, 36. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, 20,000 galls. *Pressure*: Ordinary, 30 lbs.

Financial.—Cost, $15,000. Capital stock, $10,000. Debt, $8,500. Int., 10%. Ann. op. exp., $1,080. Ann. rev.: consumers, $1,080; city, $400.

Management.—Prest., Ira S. Fleck. Secy., H. Eyler. Supt., W. H. Biays.

BURLINGTON, *Coffey Co.* (Pop., 676; est., 4,000.) On Neosho river. Has water-power used in milling.

History.—Built in '86-7 by Burlington Water-Works Co., under a 20 years' franchise. Engr., Jas. A. O'Neil.

Water Supply.—Neosho river, filtered into a reservoir, thence by pumping to stand-pipe.

Reservoir.—About 100 ft. in diam.

Pumping Machinery.—Deane pumps, dy. cap., 2,000,000 galls.

Stand-Pipe.—Cap., about 40,000 galls.; 8 ft. in diam. by 120 ft. high. Contr., Jno. O'Brien, St. Louis, Mo.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i., lead. *Taps*, 280. *Meters*, not given. *Hydrants*, Chapman, 70. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, not given, but est., $60,000. Debt, $60 000. Int., 6%. Ann. op. exp., withheld, but est., $3,500. Ann. rev.: consumers, withheld, but est., $7,000; city, $3,500. Hydrant rental, $50.

Management.—Prest., H. L. Jarboe. Secy. and Treas., C.H. Race.

CALDWELL, *Sumner Co.* (Pop., 1,005; est., 3,000.)

History.—Built in '86 by Post Martin & Co., under a 20 years' franchise. A mortgage on the works has been foreclosed, and in '88 they were in the hands of a Receiver, S. H. Horner. Des. Engr., A. N. Jones. Const. Engr., J. Simmons. Contrs., Jones & Tiernan.

Water Supply.—Well and creek, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Worthington compound and high-pressure pumps.

Stand-Pipe.—Cap., 220,000 galls.; 12 by 150 ft. Furnished by Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, 12 to 4-in. c. i., 5 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, Eclipse, 50.

Consumption, 85,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 160 lbs.

Financial.—Cost, $50,000. Capital stock, $100,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,560; city, $2,500. Hydrant rental $50.

Management.—Receiver, S. Harvey Horner.

CHERRY VALE, *Montgomery Co.* (Pop., 690; est., 3,500.)

History.—Built in '85 by Cherry Vale Water & Mfg. Co., under a 21 years' franchise.

Water Supply.—Drum creek, pumping from impounding reservoir to stand-pipe.

Reservoir.—Formed by dam. Not described.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; three Deane pumps.

Stand-Pipe.—Cap., about 35,000 galls.; 8 by 100 ft. Contrs., Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. Pipe and specials furnished by Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 53. *Valves*, Chapman.

Consumption, 50,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 70 lbs.

Financial.—Cost, $102,000. Capital stock, $200,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $2,800. Ann. rev.: consumers, $1,929; city, $3,100. Hydrant rental, $60 each for 45, and $50 for additional.

Management.—Prest., J. A. Handley. Secy., C. T. Ewing, Thayer. Supt., E. K Davis.

CLAY CENTRE, *Clay Co.* (Pop., 1,753; est., 8,000.) On Republican river.

History.—Built by Clay Centre Water Co., under a 20 years' franchise. Engrs. and Contrs., Drake & Orton.

Water Supply.—Surface water, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly-Gaskill duplex pump.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i., lead. *Taps*, 198. *Meters*, 1. *Hydrants*, Holly, 41.

Consumption, 10,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, about $80,000. Capital stock, $100,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,500; city, $4,000. Hydrant rental, $100 each for first 50, and $75 for additionnl.

Management.—Prest., A. A. Godard. V. Prest., C. E. Gifford. Secy. and Treas., D. A. Valentine. Supt., Ira A. Flood.

CLYDE, *Cloud Co.* (Pop., 956; est., 1,700.) On Republican river.

General Description.—Built in '87 by village. Deane pumps lift water to a 1,000,000-gall. reservoir. There are four miles of pipe and 40 hydrants. Supt. and Engr., S. R. Kinch.

COLUMBUS, *Cherokee Co.* (Pop., 1,164; est., 2,300.)

General Description.—Built in '87. Contrs., Long & Doubleday, Columbus. Two pumps lift water to a 150-ft. stand-pipe. No other data can be obtained.

CONCORDIA, *Cloud Co.* (Pop., 1,853; est., 4,000.) In coal region and has stone quarries.

History.—Built in '87-8 by town. Des. Engr., Galen W. Pearson, Kansas City, Mo. Const. Engr., D. L. Gregg, Concordia.

Water Supply.—Platt river, pumping to stand-pipe.

Pumping Machinery.—A 1,000,000-gall. duplex Deane pump.

Stand-Pipe.—Cap., 95,000 galls.; 15 by 75 ft.

Distribution.—*Mains*, c. i., 6 miles. *Services*, lead, iron. *Hydrants*, Galvin, 52. *Valves*, Galvin.

Pressure: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Cost, $45,000. Debt, $45,000. Int., 5%.

Management.—Not given. Address J. G. Greene. Report by W. J. Cooper.

CONWAY SPRINGS, *Sumner Co.* (Pop., 258; est., 1,000.)

General Description.—Built in '88 by Conway Springs Water Co. Water is pumped from a well to a stand-pipe, 6 ft. in diam. and 80 ft. high. Bonded debt, $13,000. Int., 7%. Officers: G. W. Faho, G. B. Armstrong and E. E. Baird.

COOLIDGE, *Hamilton Co.* (Pop., est., 1,500.)

History.—Built in '88-9 by Peck Water-Works Co., under a 50 years' franchise. Des. Engr., E. H. Peck, Coolidge. Const. Engr., Wm. Fankisley.

Water Supply.—Flowing artesian well, pumping from receiving reservoir to stand-pipe and direct. The well is tubed, 6 in. in diam. and 298½ ft. deep, and yields about 170,000 galls. a day.

Receiving Reservoir.—Cap., 390,000 galls.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; duplex pump, make not given.

Stand-Pipe.—Cap., about 100,000 galls.

Distribution.—Not given.

Financial.—Cost, $30,000. No further data given.

Management.—Prest., E. N. Peck. Supt., Secy. and Treas., E. H. Peck.

COUNCIL GROVE, *Morris Co.* (Pop., 1,041; est., 3,800.)

History.—Built in '87-8 by Council Grove Water Co., under a 20 years' franchise. Des. Engr., W. E. Allen, New York City. No general Contrs.

Water Supply.—Source not given, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls. Davidson pump.

Distribution.—*Mains*, c. i., 4 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Hydrants*, Ludlow, 35. *Valves*, Ludlow.

Pressure: 60 lbs.

Financial.—Not given.

Management.—Prest., Danl. Runkle. Secy., W. E. Stiger, New York City. Supt. F. Armstrong.

CULLISON, *Pratt Co.* (Pop., est., 500.)

History.—Built in '88 by village and Wichita & Western R. R. Co., city owning distribution system only. Des. Engr., F. Wm. Raeder, St. Louis, Mo. Contr., Guido Jaeger, Rich Hill, Mo.

Water Supply.—Well, pumping to tank. The well is 18 ft. in diam. and 110 ft. deep.

Pumping Machinery.—Dy. cap., 400,000 galls.; Knowles pump.

Tank.—Not described.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, 30. *Meters*, 1. *Hydrants*, 8. *Valves*, Chapman.

Consumption, not given. *Pressure*: Ordinary, 30 lbs. Fire, 90 lbs.

Financial.—Cost to city, $6,500. Debt, do., $6,500. Int., 7%. All water for domestic use passes through the meter and is paid for at the rate of 10 cents for 1,000 galls. In case of fire the tank connection is shut off, and water pumped direct, for which the village pays $400 a year.

Management.—Not given.

DODGE CITY, *Ford Co.* (Pop., 996; est., 5,000.) On Arkansas river.

General Description.—Built since '86 by a private company. Two 750,000-gall. Smith & Vaile pumps lift water to a reservoir or tank with a cap. of 86,000 galls. There are 9 miles of mains and 50 hydrants. Fire pressure, 91 lbs. Address Geo. F. Jones or F. A. Heinecke. No farther data given.

DOWNS, *Osborne Co.* (Pop., 465; est., 1,600.)

History.—Built in '88 by village. Contr., E. Sutphin, St. Louis, Mo.

Water Supply—Eight Wagner wells, pumping to stand-pipe.

Pumping Machinery.—A 500,000-gall. compound duplex Deane pump.

Stand-Pipe.—Cap., 100,000 galls.

Distribution.—*Mains*, 6 and 4-in. iron, 2.8 miles. *Hydrants*, 20.

Financial.—Cost, $30,000. Bonded debt, $30,000, running 30 years. Int., 6%.

Management.—City Clerk, J. M. Bower. Supt., Jas. Turner.

EL DORADO, *Butler Co.* (Pop., 1,411; est., 6,000.) On Walnut river.

History.—Built in '87 by El Dorado Water Supply Co.

Water Supply.—Well, pumping to stand-pipe and direct.

Pumping Machinery.—Blake pump, dy. cap., 2,000,000 galls.

Stand-Pipe.—Cap., 120,000 galls.; 12 ft. in diam. and 150 ft. high.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 200. *Meters*, 6. *Hydrants*, Nelson, 67.

Consumption, 175,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 120 lbs.

Financial.—Cost, "don't know," but est., $80,000. Capital stock, $100,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $3,600; city, $3,350. Hydrant rental, $50 each.

Management.—Prest., J. F. Thompson. V. Prest., C. A. Leland. Secy., C. H Baldwin. Supt. and Treas., C. L. Turner.

ELLSWORTH, *Ellsworth Co.* (Pop., 929; est., 2,500.)

History.—Built in '86 by town. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Driven wells, pumping to tank.

Pumping Machinery.—Dy. cap., 580,000 galls.; one Smith & Valle and one Buffalo pump, and two 2½ by 12-ft. steel boilers.

Tank.—Cap., 100,000 galls. Furnished by Contrs.

Distribution.—*Mains*, c, i., 6 miles. *Services*, w. i. *Taps*, 140. *Meters*, none. *Hydrants*, Eclipse, 62.

Consumption, 50,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 6 and 7%. Ann. op. exp., $1,500. Ann. rev.: consumers, $1,200; city, none.

Management.—Water Comr., Jas. Nourse. Supt., Thos. J. Noble. Mayor, L. H. Seaver.

EMPORIA, *Lyon Co.* (Pop., 4,631; est., 12,000.) Between Cottonwood and Neosho rivers. Engaged in manufacturing and trade. Settled in '57; incorp. a city in '70.

History.—Built in '80-2 by city, and rebuilt in '87-8. Engrs. and Contrs. for original system, Russell & Alexander. Later Contrs. for reservoirs, and trenching and pipe-laying, McRae & Lally, Detroit, Mich.

Water Supply.—Neosho river, pumping direct and to reservoir. The first supply was from a well on the bank of Cottonwood river, 25 ft. in diam. and 26 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Holly-Gaskill pumps. The first pump was a 1,000,000-gall. Holly quadruplex.

Reservoirs.—Cap., 15,000,000 galls.; two, or two basins, of equal size.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i. Pipe and specials for early work from Dennis Long & Co., Louisville, Ky.; for late work, from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 630. *Meters*, none. *Hydrants*, Holly, 123.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 140 lbs.

Financial.—Cost, $162,000. Debt, $162,000. Int., 7 and 5%. Ann. op. exp., about $6,000. Ann. rev.: consumers, $7,000.

Management.—Chairman Com., F. McCain. Supt., R. W. Jeremy.

EUREKA, *Greenwood Co.* (Pop., 1,127; est., 5,000.) On Fall river.

General Description.—Built in '88-9 by city, with J. W. Nier, Kansas City, Mo., as Des. Engr. The system as originally projected contemplated pumping from Spring creek to a reservoir. Est. cost, $45,000, raised by city bonds. There are 6 miles of pipe. No further information given time for insertion. City Clerk., H. A. Dennis. Supt., T. D. Turner.

FLORENCE, *Marion Co.* (Pop., 954; est., 2,300.) On Cotton and Doyle rivers.

History.—Built in '87-8 by Florence Water Supply Co. Des. Engr., J. W. Nier, Kansas City, Mo. Const. Engr., A. D. Hanck. Labor done by company.

Water Supply.—Cotton river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane pump.

Stand-Pipe.—Cap., 68,000 galls. Its bottom is 80 ft. above the city.

Distribution.—*Mains*, c. i., 3½ miles. *Hydrants*, Holly, 25.

Financial.—Cost, $40,000. Capital stock, $20,000. Bonded debt, $20,000. Int., 6%.

Management.—Prest., J. W. Thurston. Secy. and Treas., J. N. Strickler, Topeka.

FORT RILEY, *Davis Co.* (Pop., est., 1,500.) A Government military post.

History.—Built in '88 by U. S. Government. Des. Engr., J. B. Johnson, St. Louis, Mo. Plans were somewhat modified by Capt. Geo. E. Pond. Asst. Quarter-master, U. S. A. Const. Engr., W. H. Stair. Contrs., Jno. Dwyer & G. W. Pearsons, Kansas City, Mo.

Water Supply.—Wagner wells, near Republican river, pumping to reservoir. There are eight 6-in. wells from 50 to 65 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; compound duplex Deane pump, with 14 and 20-in. steam and 10½-in. water cylinders of 18-in. stroke.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, 8-in. c. i., about 4 miles. *Services*, galv. i.

Pressure: 60 lbs.

Financial.—Cost, $44,509. No debt or rev.

Management.—Asst. Q. M., Geo. E. Pond.

FORT SCOTT, *Bourbon Co.* (Pop., 5,372; est., 15,000.) On Marmaton river. Engaged in manufacturing and coal mining. Incorp. a town in '55.

History.—Built in '82 by Fort Scott Water Co., and reconstructed by them in '87. Des Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of New York City.

Water Supply.—Marmaton river, pumping from two impounding reservoirs to stand-pipe.

Dam and Reservoirs.—Cap., 4,000,000 galls. Two dams form reservoirs on river. The second was built in '88. No further description given.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Worthington pumps, and Brownell boilers. Formerly a Perkins pump was used.

Stand-Pipe.—Cap., 100,000 galls.

Distribution.—*Mains*, c. i. 20 miles. *Services*, galv. i. *Taps*, 750. *Meters*, 5. *Hydrants*, Chapman, 74. *Valves*, Chapman.

Consumption, 600,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, withheld, but est., $250,000. Ann. op. exp., $4,600. Ann. rev.: consumers, $14,875; city, $3,950. Hydrant rental, about $55 each for 55, and $50 for additional.

Management.—Prest., Alger. G. Black. Secy., J. W. Maguire. Treas. and Gen. Mgr., Geo. F. Wyman. Supt., H. C. Messenger.

FREDONIA, *Wilson Co.* (Pop., 923; est., 3,200.) On Fall river.

History.—Built in '87-8 by Jas. A. O'Neil, under the name of Fredonia Water Co. Mr. O'Neil designed the works and built them with days' labor. The franchise will run 20 years unless the city buys the works.

Water Supply.—Wells near Fall river, three miles from city, pumping to reservoir. A connection is made with the river, and direct pumping from either wells or river can be used.

Pumping Machinery.—Dy. cap., 2,000,000 gall.; one compound and one high-pressure Deane pump. Two steel tubular boilers made Jno. O. Brien & Co., St. Louis, Mo.

Reservoir.—Cap., 3,000,000 galls.; on a hill near, and 187 ft. above the city. Three brick walls will be built across the reservoir, between inlet and outlet, to serve as filters.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i., lead. Pipe and specials from the Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 208. *Meters*, none. *Hydrants*, Chapman, 52. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 175 lbs.

Financial.—Cost, $87,511, all paid up, stock. Ann. op. exp., $2,500. Ann. rev.: consumers, $6,000; city, $3,120. Hydrant rental, $60.

Management.—Supt., Jas. A. O'Neil. Other officers, H. C. Jarboe and C. H. Race.

GARDEN CITY, *Finney Co.* (Pop., est., 5,000.) On Arkansas river.

History.—Built in '87 by city. Des. Engr., J. W. Nelr, Kansas City, Mo. Const Engr., J. S. Humphrey, Garden City. Contrs., E. E. Palmer & Son, Kansas City, Mo

Water Supply.—Surface well, pumping to stand-pipe. The well is 17½ ft. in diam., 19 ft. deep, and has 12 ft. of water.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two compound duplex Buffalo pumps, and two 55 H. P. boilers.

Stand-Pipe.—Cap., 70,000 galls.; 10 ft. in diam. and 130 ft. high. Furnished by the Contrs.

Distribution.—*Mains*, c. i., 3 miles. *Services*, not given. Pipe and specials from So. St. Louis (Mo.) Iron Foundry. *Taps*, 100. *Meters*, none. *Hydrants*, kin not given, 40.

Consumption, not given. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $50,000. Debt, $45,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, not given, but est., $2,500.

Management.—Supt., W. E. Trull.

GIRARD, *Crawford Co.* (Pop., 1,289; est., 3,000.) In coal region. Settled in '69; incorp a city in '83.

History.—Built in '82 by city. Des. Engr., Wm. H. Burnham.

Water Supply.—Artesian well, pumping to tank. The well is 5 in. in diam. and 800 ft. deep.

Pumping Machinery.—Cap., not given. A deep well-pump is driven by 25 ft wind mill made by the U. S. Wind Engine & Pump Co., Batavia, Ill. A steam engine has been provided for use in case of emergency.

Tank.—Cap., 60,000 galls.; wooden, 24 ft. in diam. by 18 ft. deep, on a 30 ft. timber trestle.

Distribution.—*Mains*, c. i., 1 mile. *Services*, w. i. *Taps*, 35. *Meters*, none. *Hydrants*, 4.

Consumption, 8,000 galls.. *Pressure*; not given.

Financial.—Cost, $10,000. Debt, $8,000. Int., 7%. Ann. op. exp., $150. Ann. rev.: consumers, $600; city, none.

Management.—Supt., D. B. Osborne.

NOTE:—Under Distribution and Financial the data is that given in '84, as all requests for later information have been ignored.

GREAT BEND, *Barton Co.* (Pop., 1,071; est., 4,000.) On Arkansas river.

History.—Built in '87-8 by Great Bend Water Supply Co. Engr., J. A. Jones, Oswego. Most of the labor done by the day.

Water Supply.—Source not given, pumping to stand-pipe,

Pumping Machinery.—A 1,500,000-gall, Buffalo pump. Boiler from E. E. Palmer & Son, Kansas City, Mo.

Stand-Pipe.—Cap., 120,000 galls.; 12 ft. in diam. and 150 ft. high. From E. E. Palmer & Son.

Distribution.—*Mains*, 10 to 4-in. c. i., 4½ miles. *Services*, galv. i. *Taps*, 100. *Meters*, 1. *Hydrants*, 50.

Pressure: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Capital stock, $100,000. Bonded debt, $60,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,500; city, $2,560. Hydrant rental, $50.

Management.—Prest., J. F. Thompson, El Dorado. Supt., W. O. Morrison.

NOTE:—Other data not determined, or withheld.

GREENLEAF, *Washington Co.* (Pop., est., 1,300.)

History.—Built in '87. Ownership not given. Des. Engr., J. W. Nier. Const. Engr., Kenneth Allen. Both of Kansas City, Mo. Contr., E. Sutphin, St. Louis, Mo., except for wells, National Water Supply Co., Cincinnati, O.

Water Supply.—Eight 6-in. Wagner wells, pumping to stand-pipe. The wells are from 56 to 60 ft. deep, and yield more than 500,000 galls. a day. The tubes are of galv. i., with screw joints.

Pumping Machinery.—Dy. cap., 500,000 galls.; Deane compound duplex pumps.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, 6 and 4-in. iron, 2 miles. *Hydrants*, 13.

NOTE:—The Mo. Pac. R. R. is the main consumer. No other information given.

GREENSBURGH, *Kiowa Co.* (Pop., est., 2,750.)

History.—Built in '87-8 by Greensburgh Water Supply & Hydraulic Power Co., under a 30 years' franchise. Des. Engr., F. W. Raeder, St. Louis, Mo. Const. Engr., D. H. Rhodes, Kingman.

Water Supply.—Well, pumping to tank and direct. The well is 30 ft. in diam. and 96 ft. deep.

Pumping Machinery.—Dy. cap., 150,000 galls.; two compound duplex Knowles pumps, with 10-in. high and 16-in. low-pressure steam, and 8½ in. water cylinders of 12-in. stroke. Two 40 H. P. tubular Porter boilers. The pumps are in the well, 80 ft. below the surface, on rolled iron beams resting on buttresses built in the sides of wall of the well.

Tank.—Cap., 110,000 galls.; 25 ft. in diam. by 32 ft. high, on 76 ft. oak trestle. Contr., Jno. O'Brien, St. Louis, Mo.

Distribution.—*Mains*, c. i., 3 miles. *Services*, w. i. Pipe, specials, valves and hydrants bought of Ripley & Bronson, St. Louis, Mo. Trenching and pipe-laying done by Guido Jaeger, Rich Hill, Mo. *Hydrants*, 35.

Financial.—Cost, $45,000. Capital stock, $110,000. Bonds, authorized, $50,000. Int., 6%. Hydrant rental, $3,000 for 35, or about $85 each.

Management.—Prest., F. E. Gillet. V. Prest., E. W. Kinsley. Gen. Mgr. and Secy., D. H. Rhodes, Kingman, Kan.

HARPER, *Harper Co.* (Pop., est., 4,000.)

History.—Built in '86-8 by Harper Water Co., under a 21 years' franchise. Engr., C. W. Hill, Wellington.

Water Supply.—Artesian wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 750,000 galls.; two compound duplex Smith & Vaile pumps.

Stand Pipe.—Cap., 160,000 galls.; 15 ft. in diam. and 125 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, iron. Pipe and specials furnished by Shickle, Harrison & Howard Iron Co. Trenching and pipe-laying done by R. A. Wright, Harper. *Taps*, 100. *Meters*, none. *Hydrants*, Chapman, 65. *Valves*, Nelson.

Consumption, 200,000 galls. *Pressure*: Ordinary, 52 lbs. Fire, 150 lbs.

Financial.—Cost, $100,000. Capital stock, $150,000. Bonded debt, $100,000. Int., not given. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,500; city, $3,250. Hydrant rental, $59.

Management.—Prest., Jno. W. Hirst. Secy. and Treas., W. W. Clark. Supt., R. A. Wright.

HIAWATHA, *Brown Co.* (Pop., 1,375; est., 3,000.)

History.—Built in '87-8 by town. Engr. J. W. Nier, Kansas City, Mo. Contr., R P. McCormick, Kansas City, Mo.

Water Supply.—System of small wells, pumping to stand-pipe.

Pumping Machinery.—Dean pump, dy. cap., not given.

Stand-Pipe.—Cap., 120,000 galls.; 12 ft. in diam. and 130 ft. high.

Distribution.—*Mains*, c. i., 5½ miles. *Taps*, 65. *Meters*, 2. *Hydrants*,

Financial.—Bonded debt, $50,000.

Management.—City Clerk, C. H. Lawrence.

NOTE:—No further data given.

HUTCHINSON, *Reno Co.* (Pop., 1,540; est., 8,000.) On Arkansas river. Has water-power used in manufacturing.

History.—Built in '86 by Water Light and Telephone Co. Engrs., Drake & Orton, for Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Ground water, by direct pumping.

Pumping Machinery.—Dy. cap., 45,000,000 galls.; a 3,000,000-gall. compound condensing, and a 1,000,000-gall. high-pressure Holly-Gaskill pump.

Distribution.—*Mains*, c. i., 9½ miles. *Taps*, 347. *Meters*, Worthington, Hersey, 8. *Hydrants*, Holly, 111. *Valves*, Peet.

Pressure: Ordinary, 40 lbs. Fire, 200 lbs.

Financial.—Cannot be separated from telephone and electric light figures.

Management.—Prest., S. C. Millar. V. Prest., J. S. Drake. Secy., Treas. and Mgr., L. A. Beebe.

INDEPENDENCE, *Montgomery Co.* (Pop., 2,9:5; est., 5,000.) On Verdigris river.

History.—Built in '85 by Independence Water Co., under a 20 years' franchise. ontr., A. H. McCormick, Parsons, Kan.

Water Suppy.—Verdigris river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile pumps, and steel ers from Fairbanks, Morse & Co.

Tank.—Cap., about 100,000 galls.; steel, 24 ft. in diam. by 30 ft. high, on tower 80 ft. high.

Distribution.—*Mains*, c. i., 5½ miles. *Services*, w. i. *Taps*, 210. *Meters*, 4. *Hydrants*, Nelson, 53.

Consumption, 50,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 125 lbs.

Financial.—Cost, $80,000. Capital stock, $100,000. Debt, $61,000, of which $55,000 is bonds. Int., 7 and 8%. Ann. op. exp., $5,800. Ann. rev.: consumers, $1,150; city, $3,150. Hydrant rental, $60 each for 50, and $50 for additional.

Management.—Prest. and Supt., L. C. Mason. V. Prest., Mark Tulley. Secy., J. Ferguson.

JUNCTION CITY, *Davis Co.* (Pop., 2,684; est., 4,500.) On Smoky Hill and Republican rivers. Has water-power and is engaged in manufacturing and trade.

History.—Built in '87 by town. Engr., J. B. Johnson, St. Louis, Mo. Contrs., Cook & Horton, Junction City.

Water Supply.—Wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two Deane pumps.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., length not given. *Services*, iron. *Taps*, 50. *Meters*, none. *Hydrants*, kind not given, 53.

Consumption, 45,000 galls. *Pressure*; Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $48,500. Bonded debt, $50,000. Int., 6%. No further data given.

Management.—Supt., Jas. Fuller. Report by A. P. Trott.

KANSAS CITY, *Wyandotte Co.* See Kansas City, Mo.

KANSAS STATE PENITENTIARY, *Lansing, Leavenworth Co.* (Pop., 500.)

History.—Built in '84 by State, for its own use but some water is supplied to consumers in the village of Lansing. Engr., Major Waron. Labor was done by convicts.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., 345,600 galls.; Hooker-Colville pump.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, 8-in. c. i. 2 miles. *Taps*, 30. *Hydrants*, 8, one of which is for the town.

Consumption, 50,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000. No debt. Ann. op. exp., not given, but est., $1,000. Ann. rev.: from consumers in village, $40.

Management.—Supt., Wm. Patterson. Engr., Dan. Storrs.

KINGMAN, *Kingman Co.* (Pop., 970; est., 6,000.) On Ninnescah river.

History.—Built in '86-7 by City of Kingman Water & Power Co., under a 30 years' franchise. Des. Engr., F. Wm. Rieder, St. Louis, Mo. Const. Engr., N. W. Perkins. Contrs., Water, Light & Power Co., St. Louis, Mo.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—Gordon & Maxwell pump, dy. cap., not given.

Tank.—At an elevation of 113 ft.

Distribution.—Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Valves* and *Hydrants*, White, Ludlow.

Financial.—Hydrant rental, $70 each, and $25 on extensions.

Management.—Prest., M. W. Conkling, New York City. Secy., J. G. Conkling.

Note:—No further information can be obtained in time for insertion.

KINSLEY, *Edwards Co.* (Pop., 457; est., 3,200.)

History.—Built in '87-8 by town. Des. Engr., J. W. Nier, Kansas City, Mo. Const. Engr., S. Jobe, Carthage, Mo. Contrs., D. Mitchell & Co., Dodge City.

Water Supply.—Well, pumping to stand-pipe.

Pumping Machinery.—A 1,500,000-gall. Deane duplex pump.

Stand-Pipe.—Cap., 180,000 galls.; 16 by 120 ft.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Hydrants*, 25.

Pressure: 65 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 6%.

Management.—Village Clerk, Fred. Boyce.

LARNED, *Pawnee Co.* (Pop., 1,066; est., 5,000.)

History.—Built in '87 by R. L. Walker & Co., Topeka, Kan., under a 1 year' franchise. Des. Engr., J. S. Simmons. Const. Engr., J. J. Nesbit, Larned. Labor done by company.

Water Supply.—Well, pumping to stand-pipe. The well is 30 ft. in diam. and 25 ft. deep.

Pumping Machinery.—A 1,500,000-gall., Deane pump.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high. Contrs., E. E. Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 125. *Meters*, not given. *Hydrants*, Nelson, 50. *Valves*, Nelson.

Consumption, 150,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Hydrant rental, $60 each. No other data given.

Management.—Prest., N. A. English. Secy., A. N. Jones. Sup., J. J. Nesbit.

LAWRENCE, *Douglas Co.* (Pop., 8,510; est., 13,000.) On Kansas river. Has water-power and is engaged in manufacturing.

History.—Built in '86-7 by City Water Co., under a 20 years' franchise. Des. Engr., S. H. Lockett, New York City. Const. Engr., Jno. M. Walker, the present Supt. Contrs., Comegys & Lewis, New York City.

Water Supply.—Kansas river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Worthington pumps, and Heine safety boiler.

Stand-Pipe.—Cap., 240,000 galls.; 20 ft. in diam. by 105 ft. high. From Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 18 miles. *Services*, lead. Pipe and specials furnished by Shickle, Harrison & Howard Iron Co., and trenching and pipe-laying done by Jno. Maxwell, Lavenworth, Kan. *Taps*, 291. *Meters*, 9. *Hydrants*, White, 143. *Valves*, Peet.

Consumption, 250,000 galls. *Pressure*; 100 lbs.

Financial.—Cost, $120,000. Capital stock, $200,000. Bonded debt, $175,000. Int., 6 %. Ann. op. exp., $4,400. Ann. rev.: consumers, $5,200; city, $5,000. Hydrant rental, $35 each for 120, and $30 for additional.

Management.—Prest., Henry Tisdale. Supt. and Secy., Jno. M. Walker.

LEAVENWORTH, *Leavenworth Co.* (Pop., 16,546; est., 31,000.) On Missouri river, 30 to 130 ft. above it, and surrounded by a semicircular range of hills 350 ft. high; Has various manufactories. Settled and incorp. a city in '54.

History.—Built in '82 by Leavenworth City and Fort Leavenworth Water Co. Engr., Galen W. Pearsons, Kansas City, Mo.

Water Supply.—Missouri river, pumping to settling basins, and repumping to reservoir.

Pumping Machinery.—Cap., 9,000,000 galls., including the pumps used for repumping. There is a 4,000,000-gall. Holly and a 3,000,000 and a 2,000,000-gall. Pearson pump. Also six tubular boilers.

Settling Basins.—Cap., 6,000,000 galls. Are 100 ft. below the river.

Reservoirs.—Cap., 6,000,000 gall.; 216 ft. in diam. and 16 ft. deep, and 350 ft. above the river.

Distribution.—*Mains*, c. i., 23 miles. *Services*, galv. i., lead. *Taps*, 1,128. *Meters*, 310. *Hydrants*, Ludlow, 116. *Valves*, Ludlow, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 1,800,000 galls. *Pressure*; 125 lbs.

Financial.—Cost, $375,000. Debt, $324,000. Int., 6%. Ann. op. exp., $15,000. Ann. rev.: consumers, $37,455; city, $8,325. Hydrant rental, average, about $80.

Management.—Prest., L. T. Smith. V. Prest., H. D. Rush. Treas., M. H. Insley. Secy., E. P. Wilson. Supt., S. Hastings.

McPHERSON, *McPherson Co.* (Pop., 1,590; est., 6,000.) On a prairie. Has been incorp. a city.

History.—Built in '83 by city and extended in '88. Des. Engr., A. A. Richardson, Lincoln, Neb. Const. Engr., W. H. Nelson, McPherson. Labor done by the city.

Water Supply.—Two wells, 145 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., 275,000 galls.; Cook pump, driven by a 22-ft. wind-mill.

Tank.—Cap., 65,000 galls.; of wood, on a 41-ft. timber trestle in center of city.

Distribution.—*Mains*, 10 to 4-in. w. i., 2 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, Fairbanks, 20.

Consumption, 200,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—Cost, $25,000. Debt, $200,000. Int., 6%. Ann. op. exp., not given, but est., $1,750. Ann. rev.: consumers, $4,000.

Management.—City Clerk, D. C. Welch. Supt., A. Gross.

MANHATTAN, *Riley Co.* (Pop., 2,105; est., 5,000.) At junction of Big Blue and Kansas rivers. Has water-power.

History.—Built by city.

Water Supply.—Pumping system.

Pumping Machinery.—Not described.

Distribution.—*Mains*, 6 miles. *Hydrants*, 44.

Pressure: 80 lbs.

Management.—Secy., Geo. G. How. Supt., Wm. Coudray.

MAR N, *Marion Co.* (Pop., 857; est., 3,500.) On Cottonwood river.

History.—Built in '87 by Marion Water Supply, Electric Light & Power Co., under a 21 years' franchise. Contrs., E. E. Palmer & Son, Kansas City, Mo.

Water Supply.—Well, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; one compound duplex, and one single high-pressure Volker & Felthousen pumps, furnished by Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 85,000 galls.; 10 ft. in diam., and 150 ft. high. Furnished by the Contrs.

Distribution.—*Mains*, Kalamein 1.36 miles. *Services*, galv. i. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps*, 35. *Meters*, 7. *Hydrants*, 50,

Consumption. 25,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $80,000. Capital stock, $100,000. Bonded debt, $70,000. Hydrant rental, $50.

Management.—Prest., J. L. Thompson, El Dorado. Secy., J. A. Jones, Oswego Treas., F. E. Palmer, Kansas City, Mo. Supt., Taylor Riddle.

NOTE.—Other data not determined at time of report.

MINNEAPOLIS, *Ottawa Co.* (Pop., 1,084; est., 3,600.) On Solomon river. Has water-power used in manufacturing.

History.—Built in '87 by Minneapolis Water Co., under a 20 years franchise. Des. Engr., B. R. Clarke, Boston, Mass. Const. Engr., T. J. Talbot. Contrs., Turner, Clarke & Rawson, Boston, Mass.

Water Supply.—Wells, connected by a tunnel, by direct pumping. There are two wells, each 6 by 12 ft., one 40 and the other 44 ft. deep, sunk 70 ft. apart, near the Solomon river, through brown sandstone. A tunnel 6 ft. sq. connects the two, and extends beyond the first, making a total length of 94 ft. In the bottom of the first well are four 6-in. and of the second, four 5-in. drilled wells, the deepest extending 73 ft. Only one well was sunk at first, but this not meeting the demand the source of supply was extended. Water stands 13 ft. deep in the wells. The daily yield is about 1,000,000 galls., and the temperature of the water is 60 degrees F.

Pump Well.—The first well serves this purpose, being enlarged to a depth of 16 ft. from the top to receive the pumps.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; one compound and one single, duplex Blake pump. Two 60 H. P. return tubular boilers, from the Pond Engineer-Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa., and Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 200. *Meters*, 22. *Hydrants*, Ludlow, 51. *Valves*, Chapman.

Financial.—Capital stock, 100,000. Hydrant rental, $2,745 for 51, or $53.82 each; $15 for additional.

Management.—Prest., A. B. Turner, Boston, Mass. Treas., J. Wentworth Brown Secy., A. Gilbert. Supt., Ed. O. Davis.

NOTE.—Other data not determined at time of report.

NEWTON, *Harvey Co.* (Pop., 2,601; est., 6,000.) On Sand creek on level land

History.—Built in '84 by Newton Water Co., under a perpetual franchise, unless city buys the works. Engr., T. S. Moorhead, Milton, Pa.

Water Supply.—Sand creek and wells, filtered, pumping to stand-pipe.

Dam.—Forms reservoir on creek. Is 210 ft. long, 8 ft. wide on top and 16 ft. high.

Two rows of sheet piles were first driven and [probably] filled between with earth.

Impounding Reservoir.—Cap., 10,000,000 galls.

Filter and Tunnel.—The filter consists of a stone culvert under the bed of the creek, 67 ft. long, 10 ft. wide and 4 ft. high. Upon the top of this are brick, and above them 3 ft. of sand. At the end of the filter is a masonry pier enclosing a gate leading to the tunnel. The latter is 12 ft. wide, 65 ft. long, and ends in the pump-well, at a point 8 ft. above its bottom.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two Worthington pumps, one of 12 and 18-in. steam and 14-in. water cylinders, and the other of 18½-in. steam and 14-in. water cylinders, all of 10-in. stroke.

Stand-Pipe.—Cap., 400,000 galls.; iron, 30 ft. in diam., 76 ft. high, on a 45-ft. masonry tower. The ground here is 20 to 25 ft. above the city.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 40. *Hydrants*, Nelson, 110.

Consumption, 400,000 galls. *Pressure*: Ordinary, 40 to 60 lbs. Fire, 150 lbs.

Financial.—Cost, $170,000. Capital stock, $200,000. Bonded debt, $140,000. Int. 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $10,000; city, $5,500. Hydrant rental, $50.

Management.—Prest., R. M. Spivey. V. Prest. and Gen. Mgr., E. H. Hoag. Secy. and Treas., W. I. Graham. Supt., Jno. E. Ford. Pumping Engr., W. S. Davis.

NORTON, *Norton Co.* (Pop., est., 2,200.)

History.—Built in '88 by town. Engrs., Davis & Worthington, Norton. Contr., E. Sutphin, St. Louis, Mo.

Water Supply.—Eight Wagner wells, 23 ft. deep, pumping to stand-pipe and direct.

Pumping Machinery.—A 500,000-gall. Deane pump.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, 6 and 4-in. c. i., 5 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 14. *Valves*, Arthurs.

Consumption, 80,000 lbs. *Pressure*: Ordinary, 60 lbs. Fire, 200 lbs.

Financial.—Cost, $35,000. Bonded debt, $35,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,500; city, none.

Management.—Supt., E. J. Davis.

OBERLIN, *Decatur Co.* (Pop., 1,196; est., 2,000.)

History.—Built in '88 and put in operation Jan. 1, '89, by town. Des. Engr., A. A. Richardson, Lincoln, Neb. Contr., Ben. S. Clarke, Holdridge, Neb.

Water Supply.—Tube wells, pumping to stand-pipe and direct. There are 32 3-in. wells, 35 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; duplex Gordon & Maxwell pumps.

Stand-Pipe.—Cap., 80,000 galls.; 12 by 100 ft.

Distribution.—*Mains*, c. i., 2¾ miles. *Hydrants*, Adams, 22.

Pressure: Ordinary, 72 lbs. Fire, 120 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., est., $2,000. Ann. rev.: consumers, est., $2,300.

Management.—City Clerk, Geo. W. Keys.

OLATHE, *Johnson Co.* (Pop., 2,285; est., 3,800.) On Missouri river.

History.—Built in '84 by town. Consulting Engr., Galen W. Pearsons, Kansas City, Mo. Const. Engr., D. W. Pike. Labor done by local Contrs.

Water Supply.—Surface water gathered in impounding reservoir and filtered, pumping direct.

Reservoir.—Cap., 20,000,000 galls.

Filter and Pumping Machinery.—Not described.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i. *Taps*, 50. *Meters*, not given. *Hydrants*, 30.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $37,000. Debt, $37,000. Int., not given. Ann. op. exp., $800. Ann. rev.: consumers, $200.

Management.—Supt., S. C. Pettegrew.

NOTE:—Information under Distribution and Financial is for '86, as no report can be obtained for '88.

OSWECO, *Labette Co.* (Pop., 943; est., 4,000.) On Neosho river, which furnishes water-power used in milling.

History.—Built in '87 by Oswego Water Supply Co., under a 21 years' franchise. Engr. and Contr., J. Jones, Wichita.

Water Supply.—Neosho river, pumping to stand-pipe.

Pumping Machinery.—Cap., 1,500,000 galls. Two 750,000-gall. duplex Buffalo pumps, furnished by N. O. Nelson Mfg. Co., St. Louis, Mo.

Stand-Pipe.—Cap., 65,000 galls.; 10 ft. in diam. and 140 ft. high. From E. E. Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 6 miles. Pipe and specials from South St. Louis (Mo.) Foundry. *Taps*, 100. *Meters*, 60. *Hydrants*, Nelson, 50. *Pressure*: Ordinary, 65 lbs. Fire, 125 lbs.

Financial.—Cost, $60,000. Capital stock, $100,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, withheld, but est., $3,000; city, $2,500. Hydrant rental, $50.

Management.—Prest., W. M. Swentzell. Supt. and Secy., F. L. Greene.

OTTAWA, *Franklin Co.* (Pop., 4,032; est., 8,000.) On Marais des Cygnes river. Has foundries and railway machine shops, and manufactures flour, furniture, sugar and castor oil.

History.—Built in '86 by C. T. Ewing, Thayer. Const. Engr., J. H. Hess, Ottawa. Contrs. for masonry, Iona Pierson; for buildings, Shepherd & Cox. Both of Ottawa.

Water Supply.—Marais des Cygnes river and well, pumping to stand pipe.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; one compound and one high-pressure Deane pump, and two steel tubular boilers.

Stand-Pipe.—Cap., 70,000 galls.; 10 ft. in diam. and 125 ft. high. Contrs., Mid Continental Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, c. i., 10 miles. *Services*, galv. i. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 300. *Consumers*, 340. *Meters*, 4. *Hydrants*, Chapman, 77. *Valves*, Chapman.

Consumption, 130,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 110 lbs.

Financial.—Cost, $110,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $2,640. Ann. rev.: consumers, $6,765; city, $3,200. Hydrant rental, $42.50 each.

Management.—Owner, C. T. Ewing, Thayer. Supt., J. H. Hess.

PAOLA, *Miama Co.* (Pop., 2,312; est., 4,000.)

History.—Built in '85-6 by Paola Water Co., under a 20 years' franchise. Engr., S. H. Lockett. Contrs., Comegys & Lewis. Both of New York City.

Water Supply.—Bull creek, filtered, pumping to stand-pipe and direct.

Old Filter Crib.—Made of 10-in. timbers, and filled with sand and gravel. Is 24 by 40 ft., with 4-ft. filter spaces on sides and top. Sunk in the winter, through the ice.

New Filter.—Hyatt, dy. cap., 300,000 galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two compound duplex Worthington pumps, and steel tubular boilers.

Stand-Pipe.—Cap., about 80,000 galls.; 12½ by 100 ft. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 172. *Meters*, 1. *Hydrants*, Ludlow. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $2,900. Ann. rev.: consumers, $3,000; city, $4,170. Hydrant rental, $75 each for 50, and $60 for additional.

Management.—Prest., H. N. Hazzard, New York City. V. Prest., E. J. Snow. Secy. and Treas., J. A. Maguire. Supt., E. W. Robinson.

PARSONS, *Labette Co.* (Pop., 4,199; est., 10,000.) On Big Labette creek on rolling prairie land. Settled and incorp. a city in '71.

History.—Built in '83 by Parsons Water Co. Des. Engr., P. B. Perkins. Const. Engr., Chas. W. Hill.

Water Supply.—Big Labette creek, filtered and settled, pumping to tank and direct. The creek rises about 20 miles north of the cit

Dam.—Across creek; on bed rock, being 12 ft. wide at the base, 7 at the top and 12 ft. high. Length not given. Of stone in Fort Scott hydraulic cement.

Filter Gallery.—Built above dam in bed of stream, and consists of an excavation 10 by 50 ft., by 7 ft. deep, covered with timbers ⅜-in. apart, on which is a 4-ft. bed of stone and gravel.

Settling Reservoir.—Water passes from the filter to two settling reservoirs, each having a cap. of 2,500,000 galls. They are in excavation, with inner slopes paved with 10 in. of stone, grouted and plastered with cement.

Pumping Machinery.—Dy. cap., 2,225,000 galls.; Smith & Vaile pumps, and upright boilers.

Tank.—Cap., 52,670 ft.; 18 ft. in diam. and 24 ft. high, on an 80-ft. masonry tower, 147 ft. above the pumps.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. *Taps*, 200. *Meters*, 6. *Hydrants*, Chapman, 32. *Valves*, Chapman.

Consumption, 300,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $65,000. Int., 6 and 8%. Ann. op. exp., $2,000. Ann. rev.: consumers, $4,400; city, $3,100. Hydrant rental, $100 each for $30, and $50 for additional.

Management.—Prest., C. H. Kimball. Supt. and Secy., W. K. Hayes.

PEABODY, *Marion Co.* (Pop., 1,087; est., 2,200.) Manufactures carriages and windmills.

History.—Built in '86 by town. Des. Engr., J. E. Ford, Newton.

Water Supply.—Wells, pumping to tank and direct. There are five wells, one furnishing water raised by a windmill pump, and the others that by the steam pump.

Pumping Machinery.—Dy. cap., not given. A pump driven by a 24-ft. windmill and a Knowles steam pump.

Tank.—Cap., 60,000 galls.

Distribution.—*Mains*, w. i., 3 miles. *Services*, galv. i. *Taps*, 40. *Meters*, none. *Hydrants*, Eclipse, 25. *Valves*, Ludlow.

Consumption, 18,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 70 lbs.

Financial.—Cost, $22,000. Debt, $15,000. Int., 7%. Ann. op. exp., $200. Ann. rev.: consumers, $300; city, $300.

Management.—Supt., W. K. Palmer. Chf. Fire Dept., L. L. Morrill.

PITTSBURGH, *Crawford Co.* (Pop., est., 5,000.)

History.—Built in '85 and put in operation Jan. 1, '86, by Pittsburgh Water & Irrigating Co. The franchise is for 21 years. Const. Engr., A. W. McCormick, Parsons, Kan.

Water Supply.—Artesian well, pumping to tank and direct.

Pumping Machinery.—A 1,000,000-gall. Worthington pump.

Tank.—Cap., 67,000 galls.; 24 ft. in diam. by 20 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and trenching and pipe laying done by Chas. Davidson, Pittsburg. *Taps*, 175. *Meters*, 20. *Hydrants*, Nelson, 30

Consumption, 200,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $55,000. Capital stock, $100,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,800; city, $1,600. Hydrant rental, $50.

Management.—Prest., Frank Playtes. Secy., J. M. Goff. Supt., R. W. Basem.

PLEASANTON, *Linn Co.* (Pop., 709; est., 1,100.) In Potosi township in coal region.

General Description.—Built by town. No Engr. employed. The pump is driven by windmill and steam, and there is a reservoir. There are 3,650 ft. of mains, 10 hydrants, and the fire pressure is 40 lbs.

Financial.—Cost, $10,000. Bonded debt, $10,000. Int., 10%. Ann. op. exp., "nothing." Ann. rev.: consumers, $700; city, $100.

Management.—Supt., Danl. Rich.

RICHFIELD, *Morton Co.* (Pop., est., 1,200.)

General Description.—Built in '88 by Richfield Coal, Gas & Water Co., in which the village has an interest. Engr., F. F. Stevens. Water is pumped from an artesian well to a reservoir. Cost, about $25,000, which was met by village bonds and cash. Prest., A. T. Spotswood.

RUSSELL SPRINGS, *Logan Co.* (Pop., est., 500.)

History.—Built in '87-8 by Russell Springs Water System & Improvement Co. Engr., J. E. Hilts, Russell Springs. No Contr.

Water Supply.—Springs, pumping to tank.

Financial.—Cost, $10,000. Capital stock, $10,000. No debt.

Management.—Prest., Jas. S. Wardner. Secy., G. S. Morgan.

NOTE:—No further data given.

SALINA, *Salina Co.* (Pop., 3,111; est., 10,000.) On Smoky Hill river, on level ground.

History.—Built in '83 by Salina Water-Works Co., under a 20 years' franchise. No engineer was employed by the company. Contrs.,Orton, Drake & Bonebrake.

Water Supply.—Surface well 38 ft. deep, by direct pumping. Connection has been made with the Smoky Hill river for use in emergency.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Holly-Gaskill compound condensing pumps.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 335. *Meters*, none. *Hydrants*, Holly, 64. *Valves*, Peet. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 20 lbs. Fire, 80 lbs.

Financial.—Cost, $102,000. Capital stock, $100,000. Bonded debt, $92,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $7,500; city, $6,050. Hydrant rental, $100 each for first 50, $75 each for next 25, and $50 for additional.

Management.—Prest. and Supt., Henry Baker. Secy., Jas. Baker. Treas., M. D. Teigue.

STERLING, *Rice Co.* (Pop., 1,014; est., 2,800.)

History.—Built in '87 by town. Engr., Jno. W. Nier, Kansas City, Mo. Labor done by local Contrs.

Water Supply.—Thirty-eight 2-in. driven wells, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane pumps. Boilers from Diamond Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 4¾ miles. *Services*, not given. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 200. *Meters*, not given. *Hydrants*, Galvin, 38. *Valves*, Galvin.

Consumption, not determined. *Pressure*: Ordinary, 40 lbs. Fire, 160 lbs.

Financial.—Cost, $50,000. Bonded debt, $42,000. Int., 6%. Other data not determined.

Management.—Comr., W. D. Sowaerback. Supt., Albert Honck.

STOCKTON, *Rooks Co.* (Pop., 411; est., 2,000.) On south fork of Solomon river.

History.—Built in '87 by town. Des. Engr., Jno. W. Nier, Kansas City, Mo. Const. Engr., W. C. Sanford, Stockton. Contr., E. Sutphin, St. Louis, Mo.

Water Supply.—Well, pumping to stand-pipe and direct. The well is 18 by 34 ft.

Pumping Machinery.—A [illegible]00,000-gall. compound duplex Deane pump.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. and 100 ft. high. Made at Diamond Boiler Works, Kansas City, Mo.

Distribution.—*Mains*, c. i., 4.7 miles. *Services*, w. i. Trenching and pipe-laying done by Parker & Lake, Clyde, Kan. *Taps*, 100. *Meters*, not given. *Hydrants*, kind not given, 25.

Consumption, 150,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 80 to 90 lbs.

Financial.—Cost, $33,000. Debt, $33,000. Int., 5%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,200.

Management.—Supt., Wm. C. Sanford.

TOPEKA, *Shawnee Co.* (Pop., 15,452; est., 40,000.) On Kansas river on an undulating prairie. Engaged in manufacturing and trade. Settled in '56; incorp. a city in '57.

History.—Built in '81-2 by private company, name not given. The franchise runs for 99 years, but the city has the privilege of buying the works at the end of any 20 years. Contrs., Russell & Alexander.

Water Supply.—Kansas river, through two wells, by direct pumping. The first well is 75 ft. in diam., on an island in the river, 80 ft. from its shore, and is sunk 7 ft. below the river bottom. The sides are cemented. The second well is 60 ft. in diam. A suction pipe leads from the first well to the pump-house near the river bank.

Pumping Machinery.—Cap., 7,000,000 galls.: 3,000,000 gall. Holly quadruplex, and 4,000,000 gall. Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 28 miles. *Services*, w. i. Pipe and specials on first contract from Dennis Long & Co., Louisville, Ky. *Taps*, 1,450. *Meters*, 60. *Hydrants*, Holly, 258. *Valves*, Ludlow.

Consumption, about 800,000 galls. *Pressure*: Fire, 110 lbs.

Financial.—Cost, $200,000. Capital stock, $200,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., not given for '88, but est., $14,000. Ann. rev.: not given, but est., $30,000; city, $12,100. Hydrant rental, $44.66 each for 150, and $50 for additional.

Management.—Prest., Joab Mulrane. V. Prest., A. S. Johnson. Treas., J. R. Mulrane. Secy. and Supt., M. O'Brien. Pumping Engr., M. J. Zollinger.

UDALL, *Cawley Co.* (Pop., est., 700.)

History.—Built in '88 by village. Contr., Jno. Ford, Newton, Kan.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Dy. cap., about 150,000 galls.; furnished by U. S. Wind Engine & Pump Co., Batavia, Ill.

Tank.—Cap., 35,000 galls.

Distribution.—*Mains*, 5-in., ½ mile. *Taps*, 27. *Meters*, none. *Hydrants*, 7.

Consumption, 5,000 galls. *Pressure*: Ordinary, 125 lbs.

Financial.—Cost, $7,000. Bonded debt, $6,000. Int., 6%. Ann. op. exp., $100. Ann. rev.: consumers, $150.

Management.—Chn. Com., W. H. Gray. Supt., Jno. Vanlue.

VALLEY FALLS, *Jefferson Co.* (Pop., est., 1,600.) On Delaware river. Has good water-power used in manufacturing.

History.—Built in '88 by town. Engrs. and Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill. The town built the well.

Water Supply.—Well, pumping to tank. The well is 16 ft. in diam., 30 ft. deep and 300 ft. from Delaware river.

Pumping Machinery.—Not described.

Tank.—Is 20 by 30 ft., on a 35-ft. stone tower, the bottom of the tank being 105 ft. above the main street.

Distribution.—*Mains*, 6 and 4-in c. i., 1½ miles. *Hydrants*, 12.

Financial.—Cost, $15,300. Bonded debt, $15,000. Int., 7%.

Management.—Chn. Com., C. C. Lord. Secy., H. D. Butts.

WELLINGTON, *Summer Co.* (Pop., 2,694; est., 10,000.)

History.—Built in '84-5 by Wellington Water Co., under a 20 years' franchise. Engr., C. W. Bill.

Water Supply.—Slate creek, pumping from settling basin to tank and direct.

Settling Basin.—Is 200 ft. sq.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. Smith & Vaile pumps.

Tank.—Elevated. No further description.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 400. *Meters*, 5. *Hydrants*, kind not given, 63.

Consumption, 500,000 galls. *Pressure*: 45 to 100 lbs.

Financial.—Cost, in '85, $110,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 7%. Ann. op. exp., withheld, but est., $4,000. Ann. rev.: consumers, withheld, but est., $10,000; city, $3,650. Hydrant rental, $60 each for 50, and $50 for additional.

Management.—Prest., C. F. Harges. Treas., J. W. Hamilton. Supt., O. H. Kennedy.

WICHITA, *Sedgwick Co.* (Pop., 4,911; est., 35,000.) At confluence of Big and Little Arkansas rivers on level ground. Engaged in manufacturing, and is an important railroad center. Settled in '72.

History.—Built in '82 by Wichita Water Co., which is owned by the American Water-Works & Guarantee Co., Ltd., Pittsburg, Pa. The franchise is for 21 years. Des. Engr., J. A. Jones.

Water Supply.—Driven wells and Big Arkansas river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; Walker and Deane pumps. Two 1,750,000-gall. Smith & Vaile pumps were first used.

Stand-Pipe.—Plate iron, 2½ ft. in diam. and 150 ft. high.

Distribution.—*Mains*, c. i., Wyckoff wood, 20 miles. *Services*, galv. i. *Taps*, 713. *Meters*, none. *Hydrants*, Ludlow, White, 150.

Consumption, 750,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, withheld. Capital stock, $500,000. Bonded debt, $350,000. Int., not given. Ann. op. exp. and rev., withheld. Hydrant rental, $56.66.

Management.—Main offices, Pittsburg, Pa. Supt., F. C. Armstrong.

WINDOM, *McPherson Co.* (Pop., est., 400.)

History.—Built in '88 by town. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Cap., not given; Curtis double-acting pump, driven by a windmill.

Tank.—Cap., 40,000 galls.

Distribution.—*Mains*, 4-in. Kalamein i., 1 mile. *Services*, i. *Hydrants*, 3.

Consumption, 3,200 galls.

Financial.—Cost, $5,880. Bonded debt, $5,000. Int., 6%.

Management.—Chr. Com., J. A. Hill.

WINFIELD, *Cowley Co.* (Pop., 2,844; est., 8,000.) On Walnut river. Settled in '70; incorp. a city in '75.

History.—Built in '83 by Winfield Water Co. Des. Engr., D. McN. Stauffer, New York City. Const. Engr., Frank Barcklay, who has also been Const. Engr. of late improvements. The franchise is for 99 years, and the hydrant contract for 21 years.

Water Supply.—Walnut river, pumping to reservoir, a suction pipe extending from a crib in the river to the pump-well.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington compound pumps. Steel boilers from the John O'Brien works.

Reservoir.—Cap., 2,000,000 galls.; has masonry walls 8 ft. thick at the bottom, 4 at the top and 10 ft. high. Is one mile from the pumps.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, galv. i. Pipe and specials furnished by Dennis Long & Co., Louisville, Ky., and trenching and pipe-laying done by Jno. Maxwell. *Taps*, 390. *Meters*, 2. *Hydrants*, Flower, 69. *Valves*, Flower.

Consumption, not known. *Pressure*: Ordinary, 53 lbs. Fire, 120 lbs.

Financial.—Cost, not given. Capital stock, $150,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $8,300.; city, $4,430. Hydrant rental, $75 and $65.

Management.—Prest., Chas. H. Payson. V. Prest., Geo. F. Thurston. Both of Portland, Me. Secy., Treas. and Mgr., J. H. Decker.

WYANDOT, *Wyandotte Co.* See Kansas City, Mo.

Water-Works Projected with Fair Prospects of Construction.

ARGENTINE, *Wyandotte Co.* (Pop., est., 5,000.) Is 5 miles from Kansas City, Mo.

Proposed System.—The town is trying to arrange for an extension of the National Water Works Co.'s system, of Kansas City, Mo.

BAXTER SPRINGS, *Cherokee Co.* (Pop., 1,177; est., 1,750.)

Proposed System.—Works to be built by private company, pumping from river to stand-pipe. River is ¾ mile distant, and a dam already built will furnish power for pumping. Est. cost., $25,000. Water Comr., H. R. Crowell.

MED LODGE, *Barber Co.* (Pop., 373; est., 1,800.)

Proposed System.—Jan. 30, '89, town was to vote on issuance of $20,000 bonds, If proposition carried works were to be built in '89. Clerk, Geo. W. Horney.

NESS CITY, *Ness Co.* (Pop., est., 1,165.) On North fork of Walnut river.

Proposed System.—Village to build a pumping system, taking water from Sun-set lake, which is near the village, and fed by large springs. Plans and specifications to be prepared and bids received in summer of '89." Est. cost., $25,000. Bonds have been voted by the village. Mayor, Ross Calhoun.

SMITH CENTRE, *Smith Co.* (Pop., est., 1,000.)]

Proposed System.—To be built by village in '89 with A. A. Richardson, Lincoln, Neb., as Engr. A 1,000,000-gall. pump will lift water from wells to a stand-pipe 12 ft. in diam. by 120 ft.

There will be 10,250 ft. of 8-in., 2,290 ft. of 6 in., and 2,289 ft. of 4 in. mains; also 16 hydrants. Est. cost, $25,000, which will be met with 6% or bonds. City Clerk, A. S. Kingsbury.

SPRINGFIELD, *Seward Co.* (Pop., not given.)

Proposed System.—The Springfield Light, Heat & Water-Works Co. was incorp. in '88 by E. A. Watson, Theo. Price and others. Capital stock, $30,000. Works are soon to be built or already in progress, but no further data can be obtained. Address J. V. Lycan or M. L. Turner.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Chetopa, *Labette Co.*; Cimarron, *Gray Co.*; Douglas, *Butler Co.*; East Wichita *Sedgwick Co.*; Ellinwood, *Barton Co.*; Fairmount, *Leavenworth Co.*; Glen Elder, *Mitchell Co.*; Goodland (formerly Eustis), *Sherman Co.*; Halstead, *Harvey Co.*; Hartland *Kearney Co.*; Horton, *Brown Co.*; Leoti, *Wichita Co.*; Nickerson, *Reno Co.*; Stafford *Stafford Co.*; Strong, *Chase Co.*; Ulysses, *Grant Co.*

NEBRASKA.

Water-Works Completed or in Process of Construction.

ALBION, *Boone Co.* (Pop., 330; est., 1,500.)

History.—Built in '87 by town. Engr. and Contr., A. L. Stragg, Omaha.

Water Supply.—Source not given, pumping from reservoir to tank and direct. Water was taken from wells until they failed.

Reservoir.—Cap., about 30,000 galls. Is one mile from tank.

Pumping Machinery.—Dy. cap., 575,000 galls. Power for pumping is furnished by an engine at L. Clark's elevator.

Tank.—Cap., 55,000 galls.

Distribution.—*Mains*, 6 and 4-in. c. i., 1½ miles. *Taps*, 7. *Hydrants*, Eclipse, 9. *Pressure*: Ordinary, 50 lbs. Fire, 120 lbs.

Financial.—Cost, $8,000. Bonded debt, $6,000. Ann. op. exp., $200. Ann. rev.: consumers, $50; city, $150.

Management.—Comr., H. P. Bull.

NOTE.—Other data withheld.

ASHLAND, *Sanders Co.* (Pop., 978; est., 1,800.) On Saline river.

History.—Built in '87-8 by village.

Water Supply.—Source not given, pumping to tank.

Pumping Machinery.—A 180,000-gall. Deane pump, and steel return flue boiler.

Tank.—Cap., 65,000 galls.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, galv. i., lead. *Taps*, not given. *Meters*, none. *Hydrants*, Galvin, 18.

Consumption, not given. *Pressure*: 115 lbs.

Financial.—Cost, $13,000. Bonded debt, $13,000. Int., 6%. Other data not determined.

Management.—Comr., A. H. Gould.

AURORA, *Hamilton Co.* (Pop., 1,232; est., 1,800.)

History.—Built in '88-9 by town. Des. Engr., W. Kiersted, Kansas City, Mo. Const. Engr., L. D. May. Contr. for labor, Geo. W. Daniels, Aurora.

Water Supply.—Wells, pumping to reservoir, stand-pipe and direct. The wells were sunk by the Cook Well Co., St. Louis, Mo.

Pumping Machinery.—Dy. cap., 750,000 galls.; Deane pump. T well pumps were furnished by the Cook Well Co.

Reservoir.—Cap., 93,000 galls.

Stand-Pipe.—Cap., 63,000 galls. Made by Porter Mfg. Co., Syracuse, N. Y.

Distribution.—*Mains*, 10 to 6-in. c. i.; from Chattanooga (Tenn.) Foundry & Pipe Co. *Hydrants*, Adams, 22.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $25,000. Bonded debt, $25,000. Int., 6%.

Management.—City Clerk, Wm. R. Hellings.

NOTE:—Other data not determined.

BEATRICE, *Gage Co.* (Pop., 2,447; est., 10,000.) On Big Blue river. Has water-power and several manufactories.

History.—Built in '86 by city. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Big Blue river, by direct pumping from reservoir.

Reservoir.—Cap. not given. About 300 ft. from river, water flowing to it by gravity.

Pumping Machinery.—Dy. cap., 3,000,000 galls; one 1,500,000-gall. compound condensing, and one simple condensing Holly-Gaskill pump.

Distribution.—*Mains*, c. i., 7 miles. *Services*, not given. *Taps*, 200. *Meters*, 3. *Hydrants*, Holly, 77. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $4,200.

Management.—Comr., W. A. Warner.

BLAIR, *Washington Co.* (Pop., 1,317; est., 3,000.)

History.—Built in '86 by town. Des. Engr., F. W. Felton, Omaha. Const. Engr., Geo. Sutherland, Blair. Contrs., Fairbanks & Co., St. Louis, Mo.

Water Supply.—Thirty 2-in. tube wells, pumping to reservoirs.

Pumping Machinery.—An 800,000-gall. Smith & Vaile pump.

Reservoirs.—Cap., 150,000 each. Two, each 40 ft. in diam. by 16 ft. deep.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, 80. *Meters*, 1. *Hydrants*, kind not given, 23.

Consumption, 100,000 galls. *Pressure*: Ordinary, 110 lbs. Fire, 150 lbs.

Financial.—Cost, $20,000. Debt, $20,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $900; city, $4,500.

Management.—Supt., J. S. Cook.

BROKEN BOW, *Custer Co.* (Pop., est., 2,500.)

History.—Built in '88-9 by Broken Bow Water-Works Co., under a 20 years' franchise. Engr., Geo. W. Sturtevant, Minneapolis, Minn. Contr., C. A. Weeks, Broken Bow.

Water Supply.—Ten wells, each 100 ft. deep, pumping to reservoir. Water in the wells rises nearly to the surface.

Pumping Machinery.—A 1,000,000-gall. Worthington pump, and a 60 H. P. boiler.

Reservoir.—Cap., 1,250,000 galls.

Distribution.—*Mains*, 10 to 4-in. c. i., 3.1 miles. *Hydrants*, Holyoke, 34. *Valves*, Peet.

Pressure: from reservoir 70 lbs.

Financial.—Cost, $37,500. Capital stock, $50,000. Bonded debt, $25,000. Int., 7%. Hydrant rental, $85 each until 150 water takers are secured, and $75 each thereafter.

Management.—Prest., Jno. Reese. Secy., O. J. Collman.

CENTRAL CITY, *Merrick Co.* (Pop., 648; est., 2,000.)

General Description.—Built in '88-9 by village. Contr., Ben. S. Clarke, Holredge. Water is pumped to a stand-pipe built by E. E. Palmer & Son, Kansas City, Mo. Est., cost, $20,000. In progress at time of report. No more information given. Mayor, Wm. Patterson.

CHADRON, *Dawes Co.* (Pop., est., 3,200.)

General Description.—Built in '88 by town. Consulting Engr., A. A. Richardson, Lincoln, Neb. Const. Engr., P. M. Pritchard. Water is pumped from Chadron creek, three miles, to a reservoir 100 ft. in diam. Dy. cap. of pumps, 1,500,000 galls Fire pressure, 120 lbs. Cost, $35,000. Bonded debt, $35,000. Int., 6%. Comr., Robt. Hood. Deputy City Clerk, A. G. Fisher. No more information can be obtained.

COLUMBUS, *Platte Co* (Pop., 2,141; est., 4,000.) At junction of Platte & Loup rivers.

History.—Built in '86 7 by town. Des, Engrs., House & Kiersted, Omaha. Const. Engr. and Contrs., Chas. Schroeder, Columbus.

Water Supply.—Sixteen 3-in. driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Smith & Vaile pump, and Brownell boiler. Both bought of Fairbanks & Co., St. Louis, Mo.

Stand-Pipe.—Cap., 80,000 galls.; iron, 12 ft, in diam, by 100 ft. high. Made by E. E. Palmer, & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 3 miles. *Services*, galv. i., lead. Pipe and specials bought of Ripley & Kimball, St. Louis, Mo. *Taps*, 70. *Meters*, none. *Hydrants*, kind not given. 26.

Consumption, 200,000 galls. *Pressure*: Ordinary, 40 to 45 lbs. Fire, 100 to 125 lbs.

Financial.—Cost, $25,000. Debt, not given. Int., 6%. Ann. op. exp., $1,500. Ann rev.: total, $2,000.

Management.—Comr., O. L. Baker. Pumping Engr., Wm. Roustson.

CRETE, *Cherry Co.* (Pop., est., 2,800.) On Big Blue river. Has manufactories.

History.—Built in '88 by A. L. Strang, Omaha, under a 25 years' franchise. Des. Engr., Andrew Rosewater, Omaha.

Water Supply.—System of wells, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, 12 to 6-in., about 4½ miles. *Hydrants*, 50.

Financial.—Est. cost, $35,000. Hydrant rental, $60.

Management.—Address A. L. Strang, Omaha. City Clerk, F. D. Williams.

Note.—Other data not determined at time of report.

CULBERTSON, *Hitchcock Co.* (Pop., 704; est., 1,500.) At junction of Republican and Frenchman rivers.

History.—Built in '80-9 by town. Engrs. and Contrs., S. K. Felton Co., Omaha.

Water Supply.—Tube well, pumping to tank.

Pumping Machinery.—Windmill pump.

Tank.—Cap., about 90,000 galls.; 20 by 30 ft., on elevation.

Distribution.—*Mains*, 6 and 4-in. c.i., 3,000 ft. *Taps*, 25. *Meters*, none. *Hydrants* Eclipse, Chapman, 50.

Pressure: Ordinary, 50 lbs.

Financial.—Cost, $5,200.

Management.—Village Clerk, L. E. Crews.

Note.—No further information given.

DAVID CITY, *Butler Co.* (Pop., 1,000; est., 3,000.)

History.—Built in '88 by city. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Chas. Schroeder, Columbus.

Water Supply.—Two Cook wells, pumping to stand-pipe and direct.

Pumping Machinery.—A 1,000,000-gall. Buffalo pump, with Cook pumps for the wells. The main pump and boilers were furnished by the Pond Engineering Co. St. Louis, Mo.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 3 miles. Pipe and specials from Ohio Pipe Co., Columbus, O. *Taps*, 20. *Hydrants*, Tamaqua, 22. *Valves*, Peet.

Pressure: Ordinary; 45 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Bonded debt, $22,000. Int., 5%.

Management.—Supts., W. T. Richardson and F. A. Snow.

Note:—No further information given.

EDGAR, *Clay Co.* (Pop., 577; est., 2,000.)

General Description.—Built in '88-9 by town. Des. Engr., A. A. Richardson Lincoln. Contr., Ben. S. Clarke, Holdredge. The pumps were bought of the Cook Well Co., St. Louis, Mo., and the stand-pipe built by E. F. Palmer & Son, Kansas City, Mo. Est. cost, $22,000. Bonded debt, about $22,000. No further information can be obtained.

FALLS CITY, *Richardson Co.* (Pop., 1,583; est., 3,000.)

History.—Built in '88 by city. Engr., W. Kiersted, Kansas City, Mo. Contr., S. K. Felton, Omaha.

Water Supply.—Ground water, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; duplex non-compound non-condensing Knowles pump. and Haxteem boilers.

Stand-Pipe.—Cap., about 85,000 galls.; 12½ ft. in diam. by 100 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles. Pipe and specials from Shickle, Harrison & Howard Iron Co., and trenching and pipe-laying done by S. K. Felton, Omaha. *Hydrants*, Eclipse, 23. *Valves*, Ludlow.

Pressure: Ordinary, 40 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $28,000. Bonded debt, $28,000. Int., 5%.

Management.—City Clerk, J. Branner.

NOTE:—Other figures not determined.

FREMONT, *Dodge Co.* (Pop., 3,013; est., 8,000,) One mile from Platte river.

History.—Built in '85-6 by city. Engr., Geo. C. Morgan.

Water Supply.—Driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Deane high-pressure pump.

Stand-Pipe.—Cap., 30,000 galls.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, iron, lead. *Taps*, 60. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 40,000 galls. *Pressure*: Ordinary, 43 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $1,000.

Management.—Comr., Arthur Gibson.

GRAND ISLAND, *Hall Co.* (Pop., 2,963; est., 10,000.) A railroad and manufacturing center.

History.—Built in '86 by city. Des. Engr., A. A. Richardson. Const. Engr., and Contrs., A. L. Strang Co., Omaha.

Water Supply.—Thirty-six 2-in. driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000 gall. Knowles pumps.

Stand-Pipe.—Cap., 80,000 galls.; 12 by 100 ft.

Distribution.—*Mains*, 10 to 4-in. c. i., 14½ miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky. *Taps*, 238. *Meters*, Crown, 4. *Hydrants*, Chapman, 72. *Valves*, Chapman.

Consumption, 500,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 140 lbs.

Financial.—Cost, $73,000. Bonded debt, $73,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $5,300.

Management.—Comr., Geo. Loan, Sr. Supt., David Gilbert.

HASTINGS, *Adams Co.* (Pop., 2,817; est., 12,000.) Engaged in manufacturing.

General Description.—Built in '86-7 by city. Contrs., A. L. Strang Co., Omaha. Water is pumped from tubular wells to a stand-pipe. Cost, about $80,000. Comr., J. D. Mines. No other data can be obtained.

HOLDREDGE, *Phelps Co.* (Pop., est., 3,200.)

History.—Built in '88 by Holdredge Water Co., under a 20 years franchise. Des. Engr., A. A. Richardron, Lincoln. Const. Engr. and Contr., Ben. S. Clarke, Holdredge. Sub-Contr. for masonry, T. E. Farrell, Hastings; for buildings, Martin Johnson, Hastings, and A. L. Metcalf, Lincoln.

Water Supply.—Two wells, pumping to reservoir and repumping to stand-pipe and direct. The wells are 200 ft. deep, with 60 ft. of water.

Pumping Machinery.—Water is raised from the wells by two 12 by 36-in. vertical pumps, and is repumped by a 1,500,000-gall. high, and a 1,000,000-gall. low-pressure pump. These and boilers from Pond Engineering Co., St. Louis, Mo.

Receiving Reservoir.—Is 36 by 46 ft., by 10 ft. deep.

Stand-Pipe.—Cap., 140,000 galls.; 15 ft. in diam. by 110 ft. high. Made by Excelsior Machine & Boiler Works, Chicago, Ill.

Distribution.—*Mains*, c. i., 4 miles. *Services*, galv. i., lead. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 50. *Meters*, none. *Hydrants*, Adams, 52. *Valves*, Ross.

Consumption, not determined. *Pressure*: Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $62,000. Capital stock, $31,000. Bonded debt, $30,000. Int., 5½%. Ann. op. exp., not determined. Ann. rev.: consumers, est., $4,000; city, $3,380. Hydrant rental, $65.

Management.—Prest., C. Thompson, Secy., Treas. and Mgr., Ben. S. Clarke.

KEARNEY, *Buffalo Co.* (Pop., 1,728; est., 5,000.) Has manufactories.

History.—Built in '87 by City Water Co., and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa. A 25 years' franchise.

Water Supply.—Driven wells and North Platte river, by direct pumping.

Pumping Machinery.—A 3,000,000-gall. Walker pump.

Distribution.—*Mains*, c. i., Kalamein i., 9½ miles. *Services*, galv. i. *Taps* and *Meters*, withheld. *Hydrants*, kind not given, 45.

Consumption and *Pressure*, not given.

Financial.—Cost, $85,000. Capital stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, but est., $3,500. Ann. rev.; consumers, withheld, but est., $4,000; city, $3,000. Hydrant rental $66.66.

Management.—Prest., W. S. Kuhn, Pittsburg, Pa. Supt., Geo. Ellis.

LINCOLN, *Lancaster Co.* (Pop., 13,003; est., 40,000.) Engaged in manufacturing and trade.

History.—Built in '85 by city. A number of driven wells have recently been sunk and other extensions made.

Water Supply.—One surface and about 100 driven wells, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. Knowles duplex pumps, and 5 by 16-ft. horizontal tubular boilers.

Stand-Pipe.—Cap., 140,000; 18 ft. in diam. by 75 ft. high.

Distribution.—*Mains*, c. i., 15 miles. *Services*, galv. i., lead. *Taps*, 1,020. *Meters*, 40. *Hydrants*, Mathews, 90. *Valves*, Ludlow, Galvin.

Consumption, 8,000,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 100 lbs.

Financial—Cost, $130,000. Debt, $120,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $16,000; city, by taxation, about $8,000.

Management.—Comr. and Supt., I. L. Lyman.

LOUP CITY, *Sherman Co.* (Pop., est., 1,500.)

History.—Built in '87-8 by city. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Chas. Schroeder, Columbus. Sub. Contr., Ralph Richards, Loup City.

Water Supply.—Four 3-in. driven wells, pumping to reservoir and direct.

Pumping Machinery.—A 250,000 gall. Buffalo pump, furnished by Pond Engineering Co., St. Louis, Mo.

Reservoir.—Is 46 ft. wide and 12 ft. deep.

Distribution.—*Mains*, c. i., 1½ miles. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works, and Ohio Pipe Co., Columbus, O.; specials from J. C. Kilner, York. *Hydrants*, Tamaqua, 13. *Valves*, Galvin.

Pressure: Ordinary, 40 to 45 lbs. Fire, 100 lbs.

Financial.—Cost, about $10,000. Bonded debt, $8,000. Int., 6%.

Management.—Village Clerk, M. H. Mead.

Note:—Other figures not determined.

NEBRASKA CITY, *Otoe Co.* (Pop., 4,183; est., 10,000.) On Missouri river. Engaged in manufacturing and trade. Laid out in '54.

History.—Built in '87 by City Water Co., under a 20 years' franchise. Des. Engr., S. H. Lockett, New York City. Const. Engr., E. A. Rudiger, the present Supt. Contrs., Comegys & Lewis, New York City, who sublet labor to local parties.

Water Supply.—Missouri river, pumping to settling basin then repumped through filters to stand-pipe.

Pumping Machinery.—Two 1,000,000-gall. compound duplex Worthington pumps, and two 80 H. P. steel boilers, furnished by Pond Engineering Co., St. Louis, Mo.

Settling Basin.—Cap., 700,000 galls.

Filters.—Hyatt, dy. cap., 300,000 galls.

Stand-Pipe.—Cap., about 85,000 galls.; 12½ ft. in diam. by 100 ft. high, with its top 231 ft. above the pumps. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 12 to 4-in., 8 miles. *Services*, not given. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, about 150. *Meters*, not given. *Hydrants*, Ludlow, 80. *Valves*, Ludlow.

Consumption, 700,000. *Pressure*: Ordinary, 100 lbs. Fire, 140 lbs.

Financial.—Cost, not given, but est., $125,000. Debt, not given. Ann. op. exp. about $4,500. Ann. rev.; consumers, $6,000; city, $4,000. Hydrant rental, $50.

Management.—Prest., D. P. Rolfe. Secy. and Treas., J. W. Maguire, New York City. Supt., E. A. Rudiger.

NELIGH, *Antelope Co.* (Pop., est., 1,300.) On Elkhorn river.

History.—Built in '87 by town. Engrs. and Contrs., A. L. Strang Co., Omaha.

Water Supply.—Elkhorn river, filtered; pumping to tank.

Filter.—Not described.

Pumping Machinery.—Knowles pump, cap. not given.

Tank.—Cap., about 55,000 galls.; wooden, 24 ft. in diam. and 18 ft. high.

Distribution.—*Mains*, 6 and 4-in. c. i., 4,000 ft. *Services*, w. i. *Taps*, 40. *Meters*, none. *Hydrants*, Eclipse.

Consumption, not given. *Pressure*: Ordinary, 30 lbs.

Financial.—Cost, $10,500. Bonded debt, $10,000. Int., 6%. Ann. op. exp., $1,000. Ann. rev : total, $800.

Management.—Comr., W. C. Estes. Secy., Fred. Thompton.

NORFOLK, *Madison Co.* (Pop., 1,216; est., 3,500.)

History.—Built in '88 by Norfolk Water-Works Co. Const. Engr., C. F. McLain, Omaha. Contrs., A. L. Strang Co., Omaha.

Water Supply.—Two 400-ft. artesian wells, pumping to stand-pipe. Connection is made with Elkhorn river for use in emergency.

Pumping Machinery.—Dy. cap., 2,300,000 galls.; a compound and a high-pressure Knowles pump. Two 60 H. P. boilers.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high. On an elevation 60 ft. above business part of city.

Distribution.—*Mains*, 10 to 4-in. iron, about 5 miles. *Taps*, 35. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 30,000 galls. *Pressure*: Ordinary, 60 lbs. Fire 120 lbs.

Financial.—Cost, $35,000. Ann. op. exp., $2,400. Ann. rev.: consumers, $700; city, $7,000.

Management.—Controlled by A. L. Strang, Omaha. Report by C. C. Voorhees.

NOTE:—Other figures not given.

NORTH PLATTE, *Lincoln Co.* (Pop., 363; est., 4,000.) Near junction of North and South Platte rivers.

History.—Built in '87 by North Platte Water-Works Co., under a 20 years' franchise, and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Driven, wells from 75 to 100 ft. deep, and North Platte river, pumping direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.

Distribution.—*Mains*, 12 to 4-in. c. i., 4½ miles. *Services*, galv. i. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 45. *Valves*, Ludlow.

Financial.—Cost, not given. Capital stock, $125,000. Bonded debt, $75,000. Hydrant rental, $65. Other figures withheld.

Management.—Prest., J. H. Purdy. Secy. and Treas., W. S. Kuhn, Pittsburgh, Pa. Supt., A. S. Barnes.

OMAHA, *Douglas Co.* (Pop., 30,518; est., 100,000.) On Missouri river on three terraces, the first a few feet above high water, and from 700 to 1,000 ft. wide; the second from 17 to 70 ft. above high water, and from 1,000 to 7,000 ft. wide; the third has an undulating surface, rising in places to an elevation of 250 ft. Founded in '55.

History.—Built in '80-1 by private company, and now owned and operated by the American Water-Works Co. Des. Engr., J. D. Cook, Toledo, O. Chf. Const. Engr., Chester B. Davis, Chicago, Ill.

Water Supply.—Missouri river, pumping to settling basins, and repumping to reservoir. The first supply was taken more than a mile above the main discharge sewer, and in 87-8 a new plant was built at Florence, 7 miles above the city, a 36-in. main leading from the settling basins here to the city.

Pumping Machinery.—Dy. cap., including repumping plant, about 45,000,000 galls. The distribution of the pumps at the different stations is not given, but there are 5,000,000-gall. low and 13,000,000-gall. high-service Allis, 7,500,000-gall. Knowles, 5,000,000 and 15,000,000-gall. Holly-Gaskill, and 700,000-gall. high-service pumps.

Settling Basins.—At the first station there are three, averaging 125 by 325 ft., by 10 ft. deep. They have inner slopes of 2 to 1, lined with brick in cement. They are used alternately. From these water passes to a clear water basin 45 by 430 ft., by 10 ft. deep, from which it is pumped to the reservoir. At the Florence plant it is unofficially reported that the settling basins have a cap. of 30,000,000 galls.

Reservoir.—Cap., 11,000,000 galls.; two miles northwest of the city, in excavation and embankment; in two divisions, each 169 by 240 ft. at water surface, by 24 ft. deep. It is lined with 1 ft. of clay puddle, covered on the slopes with brick laid dry on edge, and on the bottom with 6in. of broken stone.

Distribution.—*Mains*, c. i., 75 miles. *Services*, lead. *Taps*, 3,500. *Meters*, 400. *Hydrants*, Mathews, Holly, 880. *Pressure-recording gauge*, Edson.

Consumption, 7,500,000 galls. *Pressure*: 100 lbs.

Financial.—Cost, $3,000,000. Bonded debt, $2,000,000. Int., 6%. Ann. op. exp., $45,000. Ann. rev.: consumers, $156,000; city, $54,000. Hydrant rental, $84 each for first 250, $60 each for those on subsequent extensions, and $10 each for those placed intermediately.

Management.—Mgr., S. L. Wiley. Asst. Mgr., W. H. Hall. Supt., A. B. Hunt.

ORD, *Valley Co.* (Pop., 491; est., 1,500.)

History.—Built in '87 by town. Engr. and Contr., S. K. Felton, Omaha.

Water Supply.—Driven wells, pumping to reservoir and direct.

Pumping Machinery.—A 750,000-gall. Knowles pump and a boiler made by Porter Mfg. Co., Syracuse, N. Y.

Reservoir.—Cap., about 170,000 galls.

Distribution.—*Mains*, Kalamein i., 2¼ miles. *Services*, lead. Pipe and specials from Detroit (Mich.) Pipe & Foundry Co. *Taps*, 40. *Meters*, none. *Hydrants*, Eclipse, 14. *Valves*, Galvin.

Pressure: Ordinary, 60 lbs. Fire, 125 lbs.

Financial.—Cost, $14,000. Debt, $12,000. Int., 6%. Ann. op. exp., est., $1,000.

Management.—Chn. Water Board, Jno. W. Perry. Supt., Jno. L. York.

ORLEANS, *Harlan Co.* (Pop., 970; est., 1,200.)

General Description.—Built in '88 by village. Cost, about $10,000. Bonded debt about $10,000. No further information given. Address J. L. Robertson or Jno. R. Kennedy.

PAWNEE CITY, *Pawnee Co.* (Pop., 763; est., 3,000.

History.—Built in '87-8 by city. Des. Engr., A. A. Richardson, Lincoln. Const Engr., Chas. Shroeder, Columbus.

Water Supply.—Two 7-in. wells, pumping to stand-pipe and direct. Wells sunk by C. D. Dundas, Pawnee City.

Pumping Machinery.—Dy. cap., 2,500,000 galls.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 3½ miles. *Hydrants*, 28.

Pressure: Ordinary, 65 lbs. Fire, 125 lbs.

Financial.—Cost, $28,500. Debt, not given. Int., 6%.

Management.—City Clerk, J. M. Miller.

NOTE:—Further information not determined, or withheld.

PLATTSMOUTH, *Cass Co.* (Pop., 2,967; est., 7,500.) At confluence of Platte and Missouri rivers.

History.—Built in '86-7 by Plattsmouth Water Co., under a 20 years' franchise. Des. Engr., J. D. Cook, Toledo, O. Const. Engr., C. W. Paine. Contrs., Wiley Construction Co., Boston, Mass.

Water Supply.—Missouri river, pumping to stand-pipe.

Settling Basins.—Two; cap., 800,000 galls. each.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a compound and a simple duplex Blake pump, and two 60 H. P. return tubular boilers.

Stand-Pipe.—Cap., 285,000 galls.; 25 ft. in diam. by 80 ft. high. From Stacey Mfg. Co.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, rustless i. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, 190. *Meters*, 20. *Hydrants*, Chapman, 58. *Valves*, Chapman. *Pressure-recording gauge*, Edson.

Consumption, 160,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 80 to 100 lbs.

Financial.—Hydrant rental, $75 each. No further data given.

Management.—Prest., A. B. Turner, Boston, Mass. Treas., J. Wentworth Brown. Supt., J. W. Bush.

RED CLOUD, *Webster Co.* (Pop., 677; est., 3,500.)

History.—Built in '87 by town. Des. Engr., Jno. W. Nier, Kansas City, Mo. Const. Engr., S. Jobe.

Water Supply.—Two surface wells, pumping to stand-pipe and direct.

Pumping Machinery.—A 1,000,000-gall. Deane duplex pump.

Stand-Pipe.—Cap., 70,000 galls.; 14 ft. in diam. and 70 ft. high, on an elevation of 60 ft. Made by H. C. Darby, Kansas City, Mo.

Distribution.—*Mains*, iron, 5 miles. *Services*, galv. i. Pipe and specials bought of Ripley & Bronson, St. Louis, Mo. *Taps*, 60. *Meters*, none. *Hydrants*, Mathews, 32. *Valves*, Eddy.

Pressure: Ordinary, 56 lbs. Fire, 90 lbs.

Financial.—Cost, $25,000. Bonded debt, $25,000.

Management.—Comr., E. M. Perkins.

NOTE:—Other information not determined.

RIVERTON, *Franklin Co.* (Pop., 426; est., 700.)

History.—Built in '88 by town. Engr., S. K. Felton, Omaha.

Water Supply.—Thompson creek, pumping to tank.

Pumping Machinery.—Dy. cap., 40,000 galls.; furnished by Fiennekin Turbine Co., Dubuque, Ia.

Tank.—Is 16 by 18 ft.

Distribution.—*Mains*, Kalamein i., 2 miles. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, 8.

Consumption, about 30,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 75 lbs.

Financial.—Cost, $60,000. Bonded debt, $3,600. Int., 7%. Ann. op. exp., $150. Ann. rev.: consumers, $200.

Management.—Town Board. Report by S. B. Conner.

RUSHVILLE, *Sheridan Co.* (Pop., est., 500.)

General Description.—Built in '88 by village. Engr. and Contr., S. K. Felton, Omaha. A windmill pump lifts water to a 45,000-gall. elevated tank. There are 2,000 ft. of 6-in. c. i. pipe and 4 hydrants. Cost, $3,700. Bonded debt, $3,700. Int., 7%.

Management.—Chn. Village Board, H. W. Crow.

ST. PAUL, *Howard Co.* (Pop., 1,322; est., 2,000.)

History.—Built in '87-8 by town. Des. Engr., A. A. Richardson, Lincoln. Const. Engr. and Contr., Chas. Schroeder, Columbus.

Water Supply.—Thirty-two 2-in. driven wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 750,000 galls.; Buffalo pump, and Brownell boiler, both furnished by Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., about 50,000 galls.; iron, 12 ft. in diam. by 60 ft. high. Built by E. E. Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, c. i., 3½ miles. Pipe from Chattanooga (Tenn.) Foundry & Pipe Works, and specials from Jno. C. Kilner, York. *Hydrants*, 26.

Pressure: Ordinary, 30 to 40 lbs. Fire, 100 lbs.

Financial.—Cost, $22,000. Bonded debt, $20,000. Int., 6%.

Management.—Not given.

STROMSBURG, *Polk Co.* (Pop., 1,091; est., 2,000.) Manufactures carriages, plows and brooms.

History.—Built in '88 by town. Const. Engr. and Contr., Chas. Shroeder, Columbus.

Water Supply.—Cook wells, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000-gall. Buffalo pumps. Pumps and boilers bought of Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 22,000 galls.; 8 ft. in diam. by 60 ft. high.

Distribution.—*Mains*, c. i., 2 miles. *Hydrants*, Tamaqua, 16. *Valves*, Peet.

Pressure: Ordinary, 40 lbs. Fire, 110 lbs.

Financial.—Cost, $12,000. Bonded debt, $12,000. Int., 6%.

Management.—Mayor and Council.

SUPERIOR, *Nuckolls Co.* (Pop., est., 2,500.)

History.—Built in '88-9 by town. Des. Engr., W. Kiersted, Kansas City, Mo. Const. Engr. and Contr., S. K. Felton, Omaha.

Water Supply.—Well, 25 ft. in diam. by 30 ft. deep, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000-gall. Deane pumps, and boilers from Pond Engineering Co.

Distribution.—*Mains*, 10 to 4-in. c. i., 3 miles. *Taps*, est., 80. *Hydrants*, Chapman, 20. *Valves*, Chapman.

Pressure: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $27,000. Debt, $27,000. Int., 5%.

Management.—Chn. Com., Geo. Brown. Supt., —— Shepard.

TECUMSEH, *Johnson Co.* (Pop., 1,268; est., 2,600.) On Big Nehama river, which affords water-power.

General Description.—Built in '88-9 by town. Des. Engr., A. A. Richardson, Lincoln. Contr., Ben. S. Clarke, Holdredge. Cook pumps are used. Est. cost., $21,000. City Clerk, P. A. Brundage. No other information given.

VALPARAISO, *Saunders Co.* (Pop., 300; est., 700.) Has manufactories.

General Description.—Built in '88 by town. Des. Engr., A. A. Richardson, Lincoln. Water is pumped from a well to a 60,000-gall. reservoir. There are 2 miles of pipe and 10 hydrants. Est. cost., $15,000. Town Clerk, D. M. Denne.

WAHOO, *Saunders Co.* (Pop., 627; est., 4,400.) On Wahoo river. Settled in '76.

History.—Built in '87 by Wahoo Water-works Co., under a 20 years' franchise, and managed by American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Driven wells and Wahoo river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. Walker pumps.

Distribution.—*Mains*, c. i., 6½ miles. Pipe and specials from New Philadelphia (O.) Pipe Co., and trenching and pipe-laying done by M. Walker, Port Huron. *Hydrants*, Ludlow, 43. *Valves*, Ludlow.

Financial.—Cost, $63,000. Capital stock, $125,000. Bonded debt, $60,000. Int., 6%.

Management.—Supt., H. E. Kerr.

NOTE:—Other information not determined, or withheld.

WEEPING WATER, *Cass Co.* (Pop., 317; est., 1,200.) On Weeping Water river. Manufactures lime.

General Description.—Built in '88, at a cost of about $10,000, met by bonds. Water is pumped from wells to stand-pipe. T. M. Howard is Chn. Water Board.

WEST POINT, *Cuming Co.* (Pop., 1,009; est., 2,000.) On Elkhorn river. Has water-power used in manufacturing.

History.—Built in '86 by town.

Water Supply.—Source not given, pumping to reservoir and direct.

Pumping Machinery and Reservoir, not described.

Distribution.—*Mains*, Kalamein i., 3½ miles. *Services*, galv. i. *Taps*, 66. *Meters*, not given. *Hydrants*, kind not given, 32.

Consumption, not given. *Pressure*: Ordinary, 85 lbs. Fire, 195 lbs.

Financial.—Cost, $14,800. Debt, $16,000. Int., 6%. Ann. op. exp. and rev., not given.

Management.—Comr., B. Y. Yoder.

WISNER, *Cuming Co.* (Pop., 282; est. 600.) On Elkhorn river.

History.—Built in '84 by town.

Water Supply.—Well, pumping to tank.

Pumping Machinery.—Cap., not given. Pumping is done by Wisner Roller Mills, who own the plant. A windmill was formerly used, but it was insufficient.

Tank.—Cap., about 90,000 galls.

Distribution.—*Mains*, Kalamein i., ½ mile. *Services*, galv. i. *Taps*, 15. *Meters*, none. *Hydrants*, kind not given, 6.

Consumption, not given. *Pressure*: 60 lbs.

Financial.—Cost, $4,600. Debt, $4,000. Int., 7%. Ann. op. exp., $200. Ann. rev.: consumers, $115; city, $165.

Management.—Comr. and Supt., A. R. Graham.

YORK, *York Co.* (Pop., est., 5,000.)

History.—Built in '87-8 by York Water-Works Co. Engr., C. F. McLain. Contrs., A. L. Strang Co. All of Omaha.

Water Supply.—System of 6-in. Cook wells and connection with Beaver creek. pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a 1,000,000-gall. compound and a 1,000,000-gall. high-pressure Knowles pump.

Stand-Pipe.—Cap., 80,000 galls.; 12 by 100 ft.; on an elevation of 65 ft.

Distribution.—*Mains*, 6½ miles. *Hydrants*, Chapman, 60. *Valves*, Chapman.

Financial.—Cost, $75,000.

Management.—Prest., S. K. Felton, Omaha.

Water-Works Projected with Fair Prospects of Construction.

FORT ROBINSON, *Dawes Co.* (Pop., not given.) A U. S. military post.

Proposed System.—The U. S Government will build works in '89. A 200,000-gall. Knowles duplex pump is already in place. Spring water will be impounded, then pumped to a 95,000-gall. tank. There will be 1 mile of 6-in. c. i. mains, 1-in. w i. services, 29 taps, no meters, and 7 hydrants. The ordinary pressure will be 35, and the fire pressure, 200 lbs. Jan. 15, '89, contract was awarded to S. K. Felton, Omaha.

Report by Wm. B. Hughes, Major and Quartermaster Dept. Platte, Omaha.

GRANT, *Greely Co.* (Pop., est., 50.)

Proposed System.—An effort is being made to build works in '89. Address J. L. Beard.

MASON CITY, *Custer Co.* (Pop., est., 125.)

Proposed System.—To build works in '89. Bonds were voted in the fall of '88. Judson C. Porter, City Clerk.

Water-Works Projects Reported in '87 and '88 but Now Indefinite.

Burnett, *Madison Co.*; Hebron, *Thayer Co.*; Milford, *Seward Co.*; Minden, *Kearney Co.*; O'Neill, *Holt Co.*; Pierce, *Pierce Co.*; Ponca, *Dixon Co.*; Seward, *Seward Co.*; Sutton, *Clay Co.*; Tekamah, *Burt Co.*

DAKOTA.

Water-Works Completed or in Process of Construction.

ABERDEEN, *Brown Co.* (Pop., est., 5,000.) Has manufacturing and trade interests.

History.—Built in '83 by town under direction of City Engr.

Water Supply.—A 5½-in. flowing artesian well, 906 ft. deep, by gravity. The well has an est. dy. cap. of 3,600,000 galls.

Distribution.—*Mains*, 6 and 4-in. Kalamein i., 1.84 miles. *Services*, w. i. *Taps*, 25. *Meters*, none. *Hydrants*, kind not given, 18.

Consumption, unknown. *Pressure*: The natural pressure from the flow of the well is nearly 200 lbs. A pressure reducer keeps it at 100 lbs.

Financial.—Cost, about $14,000. Debt, $5,000. Int., 7 or 8%. Ann. op. exp., slight. Ann. rev.: consumers, $800.

Management.—Com. from Council. City Engr., W. P. Butler.

ANDOVER, *Day Co.* (Pop., est., 350.)

General Description.—The C. M. & St. P. Ry. Co. has an artesian well, and in '88 the village laid 1,400 ft. of Kalamein i. pipe, connecting with the well. Cost., $1,700. Supt., W. Carpenter.

BISMARCK, *Burleigh Co.* (Pop., 1,758; est., 3,500.) On Missouri river.

History.—Built in '87, and put in operation Jan. 1, '89, by Bismarck Water Co. The hydrant contract was for 20 years. Des. and Const. Engr., J. Albert Monroe. Consulting Engrs., Morison & Corthell, Chicago, Ill. Contrs. for masonry, buildings and reservoir, Mayock & Burns.

Water Supply.—Missouri river, pumping to reservoirs.

Pumping Machinery.—Deane pumps, dy. cap., 3,000,000 galls.

Reservoirs.—Cap., 2,000,000 galls.; two 1,000,000-gall. stone reservoirs.

Distribution.—*Mains*, c. i., 6 miles. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. Trenching and pipe-laying done by Mooney & Donaher. *Meters*, 24.

Pressure: 65 lbs.

Financial.—Cost, $110,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%.

Management.—Prest., E. H. Bly. Secy., Alex. Hughes.

NOTE:—Other information not determined, or withheld.

CHAMBERLAIN, *Brule Co.* (Pop., 1,200; est., 1,500.) On Missouri river at base of, and on bluffs rising 400 ft. above the water. Manufactures flour and cigars Settled in '87; incorp. a city in '82.

History.—Built in '84 by city. Des. Engr., B. B. Colburne.

Water Supply.—Missouri river, pumping to reservoir.

Pumping Machinery.—Dy. cap., not given; Worthington pump of 10 and 16-in. steam and 7-in. water cylinder of 10-in. stroke.

Reservoir.—Cap., about 1,500,000 galls.; 150 ft. in diam. and 12 ft. deep.

Distribution.—*Mains*, w. i., 2½ miles. *Services*, galv. i. *Taps*, 46. *Meters*, 7. *Hydrants*, kind not given, 60.

Consumption, not given. *Pressure*: 100 lbs.

Financial.—Cost, $15,000. Debt, not given. Ann. op. exp. $2,500. Ann. rev.: withheld, but est., $1,400.

Management.—Supt., C. C. Morrow.

DEADWOOD, *Lawrence Co.* (Pop., 3,777; est., 3,500.) On Whitewood creek in broken, rocky region. Settled in '76; incorp. a city in '83.

History.—Built in '79 by Black Hills Canal & Water Co., under an exclusive 20 years' franchise; leased and operated by James M. Brelsford. Engr., R. D. Millet.

Water Supply.—Whitwood creek, by gravity to tanks. The creek has a drainage area of about 120 sq. m.

Conduit.—Of 1½-in. lumber, laid 2 ft. underground, conveying water from a point 180 ft. above town to the tanks.

Tanks.—Cap, 150,000 galls.; two, each 20 by 50 ft., by 10 ft. deep. Built on ground, of 16 in. timbers, the uprights being 2 ft. apart, framed into sills and caps, and lined with 4-in. plank.

Distribution.—*Mains*, w. i., 4 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, Ludlow, 17. *Valves*, Eddy.

Consumption, about 70,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $70,000. Capital stock and bonds, withheld. Ann. op. exp., about $5,000. Ann. rev.: withheld, but est., $7,000; city, nothing allowed for hydrants.

Management.—Lessee, Jas. M. Brelsford. Supt., T. J. Grier.

ELLENDALE, *Dickey Co.* (Pop., est., 1,000.)

History.—Built in '86 by town. Engrs., Gray Bros., Milwaukee, Wis.

Water Supply—A 6-in. artesian well, mode not given, but probably by gravity.

Distribution.—*Mains*, 4-in. iron, ¾ miles. *Services*, galv. i. *Taps*, 16. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, not given. *Pressure*: Ordinary, 100 lbs. Fire, 140 lbs.

Financial.—Cost, $7,000. Bonded debt, $5,000. Int., 7%. Ann. op. exp., $150. Ann. rev.: consumers, $130; city, $130.

Management.—Supt., Jas. Lacey.

FARGO, *Cass Co.* (Pop., 2,693; est., 7,000.) On Red River of the North, 32 ft. above low water, 4 ft. above high water in '82, and 917 ft. above the sea. Settled in '73; incorp. a city in '75.

History.—Built in '89 by Fargo Water & Steam Co., under a 30 years franchise. Contrs., Holly Mfg. Co., Lockport, N. Y.

Water Supply.—Red river of the North, by direct pumping from settling basins.

Settling Basins.—Not described.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; 3,000,000-gall. Holly pumps, and a 1,500,000-gall. Holly-Gaskill.

Distribution.—*Mains*, c. i., 10½ miles. *Services*, w. i., lead. Pipe and specials for original works from Shickle, Harrison & Howard Iron Co., and laid by T. E. Cowell, Muscatine, Ia. *Taps*, 413. *Meters*, 160. *Hydrants*, Holly, 56. *Valves*, Chapman *Pressure-recording gauge*, Edson.

Financial.—Cost, $80,000. Capital stock, $29 800, paid in, with $75,000 authorized. Bonded debt, $48,000. Int., 7%. Ann. op. exp., $18,000. [Probably includes interest.

and construction.] Ann. rev.: consumers, $12.520; city, $5.480. Hydrant rental, $100 each for 50, and $80 for additional.

Management.—Prest., Chas. Sweat. Secy., W. B. Douglas.

FORT BUFORD, *Buford Co.* (Pop., 500.) A U. S. military post.

History.—Built in '86 by U. S. Government.

Water Supply.—Missouri river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 52,000 galls.; Knowles pump driven by 40 H. P. boiler in a mill.

Tank.—Is 16 by 24 ft., at an elevation of 80 ft. above the ground.

Distribution.—*Mains*, Kalamein i., 1.9 miles. *Services*, Kalamein i. *Taps*, 48. *Meters*, none. *Hydrants*, Ludlow, Wilkes Barre, 10.

Consumption, $15,000. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost., $6,000. No debt or rev. Ann. op. exp., $15.

Management.—Supt., S. J. Lillie.

FORT PEMBINA, *P. O., Pembina, Pembina Co.* (Pop., 160.) On Red river of the North, near Pembina.

History.—Built in '85-6 by U. S. Government. Des. Engr., W. H. Wood, St. Paul, Minn. Const. Engr., Chas. Dougherty, Fort Pembina.

Water Supply.—Red river of the North, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 100,000 gal's.; Knowles duplex pump and 15 H.P. upright tubular boiler. Both bought of Robt. Corey & Co., St. Paul, Minn.

Tank.—Cap., 35,000.; 20 ft. in diam. by 16 ft. high.

Distribution.—*Mains*, Kalamein i., 0.7 miles. *Services*, w. i. *Taps*, 19. *Meters*, none. *Hydrants*, Wilkes Barre, 4.

Consumption, 2.500 galls. *Pressure*: Ordinary, 29 lbs. Fire, 70 lbs.

Financial.—Cost, $4.244. No debt or rev. Ann. op. exp., about $900.*

Management.—In charge of Lieut. L. S. Roudiez, U. S. A.

FORT TOTTEN, *Ramsey Co.* (Pop., 150.)

History.—Built in '85 by U. S. Goverment.

Water Supply.—Spring, pumping to tank.

Pumping Machinery.—A 48,000-gall. Knowles pump, and a 10 H. P. upright boiler.

Tank.—Not described.

Distribution.—*Mains*, iron, 1 mile. *Services*, w. i. *Taps*, 50. *Meters*, none. *Hydrants*, kind not given, 6.

Consumption, 6,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, $6,000. No debt or rev. Ann. op., exp., $1,500.

Management.—Post Quatermaster. Lieut. W. H. C. Bowen, U. S. A.

GRAFTON, *Walsh Co.* (Pop., est., 2,500.)

History.—Built in '86 by town. No Engr. Contrs., C. H. Powett, Fargo, and Thos. Hennessey, Grand Forks.

Water Supply—A 912-ft. artesian well, by direct pumping.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Gordon & Maxwell duplex pumps.

Distribution.—*Mains*, 6-in. iron. *Services*, iron. *Taps*, 12. *Hydrants*, Holly, 12.

Consumption, not given. *Pressure*: Ordinary, 15 lbs. Fire, 120 lbs.

Financial.—Cost, $28,000. Debt, $10,000. Int., 6%. Ann. op. exp., $700. Ann. rev.: consumers, $400.

Management.—Supt., F. A. Welch. Report by D. W. Toskey.

GRAND FORKS, *Grand Forks Co.* (Pop., 1,705; est., 7,000.) On Red River of the North.

History.—Built in '82 by city. Const. Engr., W. S. Russell.

Water Supply.—Red Lake river, by direct pumping. Water is taken at a point just above the junction of the river with the Red River of the North.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; three pumps, dy. cap. not given.

Distribution.—*Mains*, c. i., Kalamein i., 7 miles. *Services*, w. i. *Taps*, 300. *Meters*, 25. *Hydrants*, kind not given, 40. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $50,000. Int., 7%. Ann. op. exp., $8,000. Ann. rev.: consumers, $6,000; city, $2,000. Hydrant rental, $50.

Management.—Supt., Frank C. Whitbeck. Report by W. R. Burly, Town Clerk.

HURON, *Beadle Co.* (Pop., 164; est., 5,000.) On James river. Has manufactories.

History.—Built in '84 by town.

Water Supply.—Flowing artesian well, by gravity; and James river, by direct pumping. The supply was formerly wholly from the latter, which is now used only in emergency. The well is 863 ft. deep, has a daily yield of over 1,500,000 galls., and when closed a pressure of 170 lbs.

Pumping Machinery.—A 1,000,000-gall. Blake pump, and two 60 H. P. boilers.

Distribution.—*Mains*, Kalamein i., 2.3 miles. *Services*, Kalamein i. *Taps*, 105. *Meters*, none. *Hydrants*, Ludlow, 17. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 100 lbs.

Financial.—Cost, $28,500. Bonded debt, $29,000. Int., 7%. Ann. op. exp., $900. Ann. rev.: consumers, $2,500; city, none.

Management.—Supt., Alex. McIntosh.

JAMESTOWN, *Stutsman Co.* (Pop., 393; est., 3,000.)

History.—Built in '87-8 by town. Contrs. for well, Gray Bros., Milwaukee, Wis.

Water Supply.—Flowing artesian well, 1,500 ft. deep, by gravity.

Distribution.—*Taps*, 4. *Hydrants*, Holly, 9.

Pressure: 95 lbs.

Financial.—Cost, $12,000. Debt, $10,000. Int., 7%.

Management.—Supt., Jno. F. Vennum.

NOTE:—Other information not determined at time of report, or withheld.

MANDAN, *Morton Co.* (Pop., 239; est., 3,000.) On Missouri river at mouth of Heart river. An incorp. city.

History.—Built in '84 by town, for fire protection.

Pumping Machinery.—Worthington pump, cap. not given.

Distribution.—*Mains*, w. i., 1½ miles. *Hydrants*, kind not given, 10. *Valves*, Ludlow.

Pressure: Fire, 140 lbs.

Financial.—Cost, $6,000. No debt. Ann. op. exp., about $25. No rev.

Management.—Supt., E. C. Rice. Report by Jno. Fogarty.

MILBANK, *Grant Co.* (Pop., est., 1,700.)

General Description.—Owned jointly by C. M. & St. P. Ry. Co., and city. No further information given. Mayor, Henry S. Volkmer.

MITCHELL, *Davison Co.* (Pop., 320; est., 5,000.) Has manufactories.

History.—Built in '87 by town, without Des. Engr. Contrs., U. S. Wind Engine & Pump Co., Batavia, Ill.

Water Supply.—Two artesian wells, pumping to reservoir and direct. One well has a natural flow.

Pumping Machinery.—Knowles pump, cap. not given.

Reservoir.—Cap., about 800,000 galls.; 110 ft. in diam. by 13 ft. deep. Of stone and cement 22 ft. above pump.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. lead. Pipe, specials, valves and hydrants from Rhodes & Ramsey, Chicago, Ill. *Taps*, about 100. *Meters*, none *Hydrants*, 27.

Consumption, not given. *Pessure*: Ordinary, 40 to 60 lbs. Fire, 100 to 150 lbs.

Financial.—Cost, $65,000. Bonded debt, $65,000. Int., 7%.

Management.—Chn. Com., W. G. Davison. Supt., J. F. Kimball.

PIERRE, *Hughes Co.* (Pop., est., 3,000.) On Missouri river.

History.—Built in '85 by Pierre Water-Works Co., under an exclusive 25 years' franchise. Contrs., Northwestern Water & Gas Supply Co.

Water Supply.—Missouri river, pumping from settling well to reservoir.

Pumping Machinery.—A 1,250,000 gall. compound duplex Worthington pump, and two boilers.

Reservoir.—Cap., 1,000,000 galls. Is 254 ft. above the town.

Distribution.—*Mains*, Kalamein, i., 6.3 miles. *Services*, Kalamein, i., lead. *Taps*, withheld. *Meters*, 45. *Hydrants*, Ludlow, 45.

Consumption, not given. *Pressure*: Ordinary, 110 lbs. Fire, 200 lbs.

Financial.—Cost, $125,000. Capital stock, $125,000, paid up. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $1,500; city, $4,500. Hydrant rental, $100 each.

Management.—Prest., G. E. Beach, Minneapolis, Minn. Secy. and Treas., M. L. Knowlton. Supt. and Engr., J. W. Troy.

PLANKINTON, *Aurora Co.* (Pop., est., 800.)

General Description.—Built in '87-8 by village. Contr., J.F. Barton, Plankinton. Water supply, flowing artesian well, by gravity. *Mains*, iron, 2 miles. *Taps*, 116. *Hydrants*, Chapman, 14. *Pressure*: 140 lbs. Cost, $8,000. Bonded debt, $10,600. Int., 7%. Mayor, Jno.Rogers. Supt., W. G. Andrews.

RAPID CITY, *Pennington Co.* (Pop., 292; est., 3,500.) On Rapid river in mining region. Has water-power.

History.—Built in '86 by town.

Water Supply.—Spring, 214 ft. above town, by gravity to reservoir.

Reservoir.—Cap., 400,000 galls.; 175 ft. above town.

Distribution.—*Mains*, Kalamein, i., 5 miles. *Services*, w. i. *Taps*, 175. *Meters*, none. *Hydrants*, Ludlow, 23. *Valves*, Ludlow.

Consumption, about 600,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $50,000. Debt, $51,000. Int., 7%. Ann. op. exp., $1,500. Ann. rev.: consumers, $4,400; city, none.

Management.—Supt., Jas. Long, Jr. Report by J. W. Fowler.

REDFIELD, *Spink Co.* (Pop., est., 1,200.) On James and Turtle rivers.

History.—Built in '86 by town. Contrs., Gray Bros., Milwaukee, Wis.

Water Supply.—Flowing artesian well, by gravity.

Distribution.—*Mains*, in principal streets. *Hydrants*, 4.

Pressure: 160 lbs.

Financial.—Cost, $5,000.

Management.—Supt., W. D. Beebe.

SALEM, *McCook Co.* (Pop., est., 800.)

History.—Built in '87-8 by village. Contr., S. K. Felton.

Water Supply.—Well, 225 ft. deep, pumping to tank.

Pumping Machinery.—Dy. cap., about 50,000 galls.; windmill pump.

Tank.—Cap., 60,000 galls.

Distribution.—*Mains*, ½ mile. *Taps*, 12. *Hydrants*, 4.

Pressure: 40 lbs.

Financial.—Cost, $6,000. Debt, $5,200. Int., 7%.

Management.—Council. Report by W. D. Roberts.

SIOUX FALLS, *Minnehaha Co.* (Pop., 2,164; est., 11,000.) On Sioux river. Has water-power and stone quarries.

History.—Built in '84 by Sioux Falls Water Co., under an exclusive 20 years' franchise, and controlled by the American Water-Works & Guarantee Co., Ltd., Pittsburgh, Pa.

Water Supply.—Wells and Sioux river, filtered, pumping to stand-pipe.

Pumping Machinery.—A 3,000,000-gall. Worthington pump.

Filter.—Cap. not given. National Water Purifying Co.s' plant.

Stand-Pipe.—Cap., about 440,000 galls.; 30 ft. in diam. by 84 ft. high.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, galv. i. *Taps*, 380. *Meters*, not given. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*; Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $105,000. Capital stock, $100,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., withheld, but est., $5,000. Ann. rev.: total, $10,485. Hydrant rental, $73.

Management.—Prest., A. W. Mellon. Secy., W. S. Kuhn, Pittsburgh, Pa. Supt., C. H. Martien.

SPEARFISH, *Lawrence Co.* (Pop., 170; est., 1,200.) Has water-powor.

History.—Built in '87 by town, under direction of L. Harper.

Water Supply.—Springs, by gravity.

Distribution.—*Mains*, 3½ miles. *Hydrants*, 17.

Financial.—Cost, $17,500. Bonds, $20,000.

Management.—Supt. L. Harper. City Auditor, Jno. A. Clark.

WAHPETON, *Richland Co.* (Pop., 400; est., 2,500.) At junction of Red river of the North and Bois des Sioux river. Engaged in manufacturing and trade.

History.—Built in '85 by Wahpeton Water Co., under a 30 years' franchise. Engr., Col. E. R. Davenport, Charleston, W. Va.

Water Supply.—Red river of the North, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Worthington pump, and steel boilers.

Distribution.—*Mains*, Kalamein i., 5 miles. *Services*, Kalamein i. *Taps*, 220. *Meters*, 1. *Hydrants*, kind not given, 26.

Consumption, 80,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 150 lbs.

Financial.—Cost, $76,500. Capital stock, $50,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, $5,600; city, $2,000. Hydrant rental, $80.

Management.—Prest. and Treas., W. A. Seely. Secy., C. R. Loomis.

WATERTOWN, *Codington Co.* (Pop., 746; est., 5,000.)

History—Built in '88 by Watertown Water-Works Co., under a 20 years' franchise.

Water Supply.—Lake Kampeska, pumping to stand-pipe.

Stand-Pipe.—Is 125 ft. high.

Distribution.—*Mains*, 8¼ miles. *Hydrants*, 80.

Financial.—Bonds, $150,000. Hydrant rental, $75 each.

Management.—Supt., M. Smith.

YANKTON, *Yankton Co.* (Pop., 3,431; est., 4,000.) On Missouri river, on a smooth plateau, with high and regular slopes on north and west. Has woolen mill and breweries. Settled in '56; incorp. in '69, and reincorp. a city in '73.

History.—Built in '84 by city. Des. Engr., Ed. Palmer. Const. Engrs. and Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Flowing artesian well, by gravity to tanks. The well has a daily yield of about 2,000,000 galls.

Tanks.—Cap., 62,000 galls.; two, of wood.

Distribution.—*Mains*, Wyckoff wood, 3½ miles. *Services*, iron. *Taps*, 110. *Meters*, none. *Hydrants*, Holly, 21.

Consumption, 240,000 galls. *Pressure*, 35 lbs.

Financial.—Cost, $30,000. Debt, $18,000. Int., 7%. Ann. op. exp., $250. Ann. rev.: consumers, $700; city, none.

Management.—Chn. Com., J. Branch. Supt., J. Karr.

Water-Works Projected with Fair Prospects of Construction.

CANTON, *Lincoln Co.* (Pop., 675; est., 1,743.) Has water-power.

Proposed System.—In Mar., '88, the city voted $10,000 of bonds for works. Water to be pumped from artesian wells to a tank. Contracts were to be let in May, and works put in operation in the fall of '88. No reply to later inquiries has been received.

Present Supply.—Four wells, owned by the city. Report by T. O. Lorron.

DEVIL'S LAKE, *Ramsey Co.* (Pop., est., 1,200.)

Proposed System.—Est. cost, $10,000. An artesian well was sunk in Nov., '88, but nothing further had been done at time of last report. City Auditor, C. M. Fisher.

SCOTLAND, *Bon Homme Co.* (Pop., 150; est., 2,000.)

Proposed System.—In Jan., '89, an Engineer was to be employed soon. Water to be taken from spring, near town, or from an artesian well. Town Clerk, J. V. Teibel.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Harold, *Hughes Co.*; Highland, *Minnehaha Co.*; Minot, *Ward Co.*

WYOMING.

Water-Works Completed or in Process of Construction.

CHEYENNE, *Laramie Co.* (Pop., 3,456; est., 10,000.) [On Crow creek, 5,900 ft. above the sea, on a plain sloping 1 ft. in 120. In mining region. Settled in '67.

History.—First supplied in '80, the U. P. Ry. putting in a Knowles pump, a tank and 3,000 ft. of mains. In '82 works were built by town. Engr., W. G. Provines.

Water Supply.—Crow creek, by gravity from a system of storage reservoirs, with direct pumping in case of fire. Improvements in the quality of the supply are being made.

Dam.—Across Crow creek, 6 miles from city. Size not given.

Conduits.—Vitrified stoneware pipes lead from the dam and connect the reservoirs. Nearly five miles of 15 and 20-in. pipe lead from the dam to the reservoirs, the fall generally being 1 ft. in 1,250 and about 3 miles are laid between the reservoirs.

Reservoirs.—Cap., 214,000,000 galls. There are four natural basins, the largest Lake Mahpealutah, having an area of 38 acres.

Supply Main.—A 12-in. cast-iron pipe leads from the larger reservoir to the city. Dy. cap., 2,514,000 galls.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two Knowles pumps.

Distribution.—*Mains*, c. i., 13 miles. *Services*, lead. Pipe and specials from Dennis Long & Co., Louisville, Ky., and Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 700. *Meters*, none. *Hydrants*, Chapman, 90. *Valves*, Chapman.

Consumption, 900,000. *Pressure*: Ordinary, 18 lbs Fire, 150 lbs.

Financial.—Cost, $250,000. Debt, $130,000. Int., 7%. Ann. op. exp., $3,500. Ann. rev.: consumers, $14,500; city, $7,000.

Management.—Chn. Com., J. W. Hammond. Supt. and Engr., Donnell Miller.

LARAMIE CITY, *Albany Co.* (Pop., 2,696; est., 5,000.) On Laramie river. In mining region, and has manufactories.

History.—Supplied since '70; works now owned by U. P. Ry. and used for their own supply, and for fire protection in the city.

Water Supply.—Springs, 2½ miles east of city, by gravity from reservoir or pond with an area of five acres.

Distribution.—*Mains*, w. i. and cement, 5 miles. *Services*, w. i. *Hydrants*, Holly, Beaumont, 24.

Pressure: 40 lbs.

Financial.—Cost, $18,000. No debt, op. exp. or rev.

Management.—U. P. Ry. Chf. of City Fire Dept., Otto Gramm.

RAWLINS, *Carbon Co.* (Pop., 1,451; est., 1,500.) In mining and stock-raising section.

NOTE:—There are works owned by village, but no report can be obtained. Address Village Clerk, or Jno. C. Friend.

ROCK SPRINGS and GREEN RIVER, *Sweetwater Co.* (Pop.: Rock Springs, 765; est., 2,500. Green River, 327; est., 500.) Rock Springs is a coal mining camp, 16 miles from Green river, up Bitter creek. The village of Green river is on Green river, and is a division station of the U. P. Ry., its only industries being those connected with the railway.

History.—In '75 the U. P. Ry. put in pumps and built a tank at Green river to supply their shops and dwellings.

In '86-8 the company built new pumping works at Green river, and laid pipe to Rock Springs. The latter place is an alkaline region, where the water cannot be used for domestic or boiler purposes. For several years a water train supplied Rock Springs, taking its supply at Green River. For the work lately done V. G Bogue, R. E. Briggs and E. C. Kinney were Des. Engrs., and the latter, Superintendent of construction. Contrs., A L. Strang Co., Omaha. A connection was made at Green river between the old and new pumping stations by a 4-in. pipe with a pressure-reducing valve, but ordinarily the two systems are operated separately.

GREEN RIVER PLANT.

Water Supply.—Green river, pumping through mains to tank.

Pumping Machinery.—Dy. cap., 150,000 galls.; two No. 9 Knowles pumps.

Tank.—Is 15 by 20 ft.

Distribution.—*Mains*, 4-in. c. i., 2 miles. *Taps*, 30. *Meters*, none. *Hydrants*, 10.

Consumption, not given; mostly at round house.

Financial.—Not given.

Management.—Foreman round house, E. A. Linsley.

ROCK SPRINGS PLANT.

Water Supply.—Green river, pumping through 16 miles of pipe directly to mains, the surplus going through a **Y** to a reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; two Knowles pumps with 7-in. plungers with 18-in. stroke. Two 100 H. P. boilers from J. Mohr & Co., Chicago, Ill.

Conduit.—Of 8-in. c. i., 16 miles long, rising about 340 ft. The first 100 ft. are of 67 lb. pipe, then comes 3 miles of 50 lb., 1 of 67, 8 of 50, and the remainder of 43 lb. pipe. An intermediate pumping station was originally intended, so the light pipe was used at the lower end. It has been proposed to relay the three miles of 50 lb. pipe with 67 lb. A mile from Rock Springs a **Y** is in inserted, and a branch run ¾ miles up into the hills to a reservoir. Just below the **Y** a check valve is inserted; both the line to the town and to the reservoir being left open. If more water comes through the main than is used at the town the surplus goes to the reservoir; if less, the reservoir supplies the deficiency.

Dam.—Of earth, built across ravine to form reservoir.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., including conduit, 22 miles; some of the distribution pipe is 4-in. but most of it is 8-in. *Services*, lead. *Taps*, 150. *Meters*, 150. *Hydrants*, Chapman, 47. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: 66 lbs.

Financial.—Cost, about $200,00. Ann. op. exp., $20,000. The rev. from consumers is small, and as most of the houses are owned by the company, and the villages unincorporated, there is no hydrant rental. The charges to the mines and locomotives will be arbitrary, as they are made simply to balance the company's accounts with its various departments.

Management.—Supt., E. C. Kinney, Green River.

Water-Works Projected with Fair Prospects of Construction.

DOUGLAS, *Albany Co.* (Pop., est., 100.)

Proposed System.—Bids for sinking artesian well, or for a complete system, were to be received in Sept., '88. No later information can be obtained. Address Alexander T. Bueller.

MONTANA.

Water-Works Completed or in Process of Construction.

ANACONDA, *Deer Lodge Co,* (Pop., est., 400.)

General Description—Built in '88. Supt. of Const., Jno. R. Toole. There is a reservoir, and 6¼ miles of 8 to 4-in. Kalamein i. mains. Report by Thos. W. Brooks.

BILLINGS, *Yellowstone Co.* (Pop., est., 1,800.)

History.—Built in '86-7 by the Billings Water & Power Co., under a 20 years' franchise. Engr., H. W. Rowley. Work let in small contracts and done by day labor.

Water Supply.—Yellowstone river, through canal, pumping direct,

Canal.—One mile long, 18 ft., wide at bottom, with 7-ft. depth of water and 12 ft. head. Furnishes power for operating two power pumps and the dynamos of the electric light plant.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; one Dean and one Blake duplex plunger water-power pump.

Distribution.—*Mains*, Kal. i., 5¼ miles. *Services*, Kal. i. *Taps*, 120, *Meters*, none. *Hydrants*, Ludlow, 15.

Consumption, 150,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.

Financial.—Cost. $60,000. Bonded debt, $39,000. Int., 7%. Ann. op. exp., $5,725, a small part of which is incurred in operating the electric light plant. Ann. rev.: consumers, $4,000; city, $1,500.

Management.—Prest., Henry Belknap. Treas., H. H. Mund. Secy. and Supt., H. W. Rowley.

BUTTE CITY, *Silver Bow Co.* (Pop., 3,363; est., 8,000.) Has extensive mining industries.

History.—Built in '82 3 by private company, under supervision of O. P. Blaine.

Water Supply.—Mountain stream, by direct pumping from reservoir.

Reservoir.—Cap., 210,000 galls.

Pumping Machinery.—A 1,000,000-gall. Knowles pump.

Distribution.—*Mains*, 10 to 5-in. c. i., 10 miles. *Services*, iron. *Taps*, not given. *Meters*, none. *Hydrants*, Ludlow, 16. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: 176 lbs.

Financial.—Cost, $120,000. Debt, $29,000, of which $27,500 is in bonds. Int., 7%. Ann. op. exp., $12,000. Ann. rev.: consumers, $26,000; city, $1,200. Hydrant rental, $100.

Management.—Prest., W. A. Clark. Treas., Percy Blaine. Secy., J. R. Wharton. Supt., O. P. Blaine.

FORT BENTON, *Choteau Co.* (Pop., est., 2,500.)

History.—Built in '87-8 by the Fort Benton Water Co., under a 20 years franchise. Engr. and Contr., Geo. F. Woolston, New York City. Labor done by company

Water Supply.—Missouri river, pumping direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake pump. Two 50 H. P. steel boilers.

Distribution.-*Mains*, Kalamein i., 5½ miles. *Services*, lead, iron. Pipe and specials from National Tube Works Co., McKeesport Pa. *Taps*, 240. *Meters*, none. *Hydrants* Ludlow, 25. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 75 lbs.

Financial.—Cost, $52,000. Capital stock, $40,000. Bonded debt, $40,000. Int., 6% Ann. op. exp., $4,200. Ann. rev.; consumers, $4,800; city, $2,500. Hydrant rental, $100 each for 25, and $75 for each additional.

Management.—Prest., Geo. F. Woolston, of New York City. Treas., F. E. Rogers. Secy., D. P. Morse. Supt., A. D, Bigelow.

FORT KEOGH, *Custer Co.* (Pop., 700.) A military post 2½ miles from Miles city.

General Description.—Built by U. S. Government, date not given. A No. 8 Blake pump lifts water from Yellowstone river to an 8,000-gall. tank. There are ¾ miles of 3-in. iron pipe. A new system has been proposed. In charge of Lieut. M. C. Martin, U. S. A.

HELENA, *Lewis and Clarke Co.* (Pop., 3,624; est., 13,000.) In mining region.

History.—Built in '87-8 by Helena Water Co., under a 20 years' franchise which is owned by Turner, Clark & Rawson. Des. Engr., B. R. Clarke and Geo. E. Evans. Const. Engrs., Geo. E. Evans and J. Frank Williams. All of Boston. Contr., Geo. F. Woolston, New York City.

The city has been supplied for several years by one or two other companies, but no description of their plants has been given.

Water Supply.—Combined surface and driven wells, pumping to reservoir. Direct pumping can be used. The well is 40½ ft. in diam., by 26½ ft. deep, with 12 driven wells, 4 to 6 in. in diam., in its bottom.

Pumping Machinery.—Dy. cap., 2,800,000 galls.; two duplex compound condensing Blake pumps, and two 100 H. P. return tubular boilers.

Reservoir.—Cap., about 2,126,000 galls., with 18 ft. of water. In embankments, 90 by 100 ft. at the bottom, with inner slopes of 1½ to 1. The bank is 21 ft. high, 81 ft. thick at the bottom and 18 at the top. The north bank has a retaining wall of masonry in cement. The high water line of the reservoir is 451.04 ft. above the center of the pump plungers.

Distribution.—*Mains*, Kalamein i., 15 miles. *Services*, galv. i. *Taps*, about 700. *Meters*, not given *Hydrants*, Chapman, 150. *Valves*, 150.

Consumption, not determined. *Pressure*: 75 lbs.

Financial.—Cost, not given. Capital stock, $300,000. Hydrant rental, $100.

Management.—Prest., B. S. Ambler. Treas., A. B. Turner. Supt., A. R. Gates.

MISSOULA, *Missoula Co.* (Pop., est., 2,000.) On Clark's fork of Columbia river, in lumber and mineral region.

History.—Built in '83 by Missoula Water-Works & Mining Co.

Water Supply.—Rattlesnake creek, by gravity.

Flume.—Is 2 by 3 ft.

Reservoir.—Cap., 40,000 galls.

Distribution.—*Mains*, Kalamein i., 3·8 miles. *Services*, w. i. *Taps*, 120. *Meters*, none. *Hydrants*, kind not given, 12.

Consumption, not given. *Pressure*: 45 lbs.

Financial.—Cost., $15,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $3,600; city, $2,000. Hydrant rental, about $166.66.

Management.—Mgr., Alfred Cove.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Miles City, *Custer Co.*

GROUP 7.—SOUTHWESTERN STATES.—Water-Works Completed, in Process of Construction or Projected, in Missouri, Arkansas, Texas, Colorado and New Mexico.

MISSOURI.

Water-Works Completed or in Process of Construction.

BOONVILLE, *Cooper Co.* (Pop., 3,854; est., 5,000.) On Missouri river, in mining and quarrying region. Engaged in manufacturing and trade. Settled about 1800.

History.—Built in '83 by Boonville Water Co., under a 20 years' franchise. Des. Engr., P. B. Perkins, Springfield.

Water Supply.—Missouri river, pumping to reservoir and tank.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; two Deane pumps and two upright 60 H. P. boilers.

Reservoirs.—Cap., 1,500,000 galls. each; in earth embankment, lined with cement, 80 and 140 ft. above city, each 100 by 250 ft., by 10 ft. deep.

Filter.—One in each reservoir, consisting of two brick walls, filled between with gravel.

Tank.—Cap., 60,000 galls.; 16 by 24 ft., and 50 ft. above the highest reservoir.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 245. *Meters*, 2. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 250,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 65 lbs.

Financial.—Cost, $84,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., withheld, but est., $4,000. Ann. rev., consumers, withheld, but est., $6,000; city, $3,000. Hydrant rental, $60.

Management.—Prest., Jno. S. Elliott. V. Prest., Wm. S. Stephens. Supt., R. Hodelich.

CARROLLTON, *Carroll Co.* (Pop., 2,313; est., 4,000.) Is six miles from Missouri river.

History.—Built in '85 by Carrollton Water-Works Co., under a 20 years' franchise.

Water Supply.—Driven wells, by direct pumping.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Holly-Gaskill pumps.

Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i., lead. *Taps*, 75. *Meters*, 2. *Hydrants*, Holly, Holly-Gaskill, 20.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $30,000. Debt, $25,000. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $1,500; city, $2,250. Hydrant rental, $90.

Management.—Prest., B. F. Jones. Secy. and Treas., Fred Wing. Supt., J. H. Turner.

CARTHAGE, *Jasper Co.* (Pop., 4,167; est., 9,500.) On Spring river. Engaged in lime and other manufacturing, and mining. Incorp. a city in '72.

History.—Built in '81-2 by Carthage Water-Works Co., under a 20 years' franchise. Engr., Jno. M. Slaney, New York City. Labor done by company.

Water Supply.—Spring river, filtered, pumping to stand-pipe and direct.

Filter.—Of stone and gravel, 25 by 50 ft., by 12 ft. deep.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two Knowles pumps, lifting water 170 ft.

Stand-Pipe.—Cap., 22,000 galls.; plate iron, 8 ft. in diam. by 60 ft. high, on ground 70 ft. above city. Built by Shickle, Harrison & Howard Iron Co., St. Louis.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 800. *Meters*, 10. *Hydrants*, Chapman, 65. *Valves*, Chapman.

Consumption, 350,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 118 lbs.

Financial.—Cost, $1,000,000. Capital stock, $100,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,800. Ann. rev.: consumers, $7,600; city, $3,450. Hydrant rental, $50 each for 60, and $25 for additional.

Management.—Prest., C. H. Malin. Secy. and Treas., H. H. Harding. Supt., C. L. Bartlett.

CHILLICOTHE, *Livingston Co.* (Pop., 4,078; est., 6,000.)

History.—Built in '87 by Chillicothe Water, Gas & Electric Light Co., under a 20 years' franchise. Des. Engr., S. H. Lockett, New York City. Const. Engr., Jno. M. Walker, Lawrence, Kan. Contrs., Comegys & Lewis, New York City.

Water Supply.—Grand river, pumping through filters to clear water reservoir, thence by repumping to stand-pipe and direct. The point of supply is two miles from town.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. duplex compound condensing Worthington pumps, and two 80 H. B. steel tubular boilers. The latter were bought of the Pond Engineering Co., St. Louis, Mo.

Filters.—Two Hyatt, dy. cap., 300,000 galls.

Reservoir.—Cap., 1,250,000 galls.

Stand-Pipe.—Cap., about 125,000 galls.; 12½ ft. in diam. by 145 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 8⅓ miles. *Services*, galv. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 59. *Meters*, 1. *Hydrants*, Ludlow, 91. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 150 lbs.

Financial.—Cost, $200,000. Capital stock, $350,000. No bonds issued to Feb., '88. Ann. op. exp., $4,000. Ann. rev.: consumers, $6,000; city, $3,185. Hydrant rental, $35 each.

Management.—Prest., Alex. G. Black. Secy. and Treas., J. W. Maguire. Supt. and Gen. Mgr., N. C. Irwin.

CLINTON, *Henry Co.* (Pop., 2,868; est., 7,000.) Has manufactories.

History.—Built in '86 by Clinton Water Co. Engr., P. B. Perkins, Springfield.

Water Supply.—Grand river, three miles distant, and six wells, pumping to reservoir, stand-pipe and direct.

Filter Crib.—Not described.

Pumping Machinery.—Perkins pump, dy. cap., not given.

Reservoir.—Cap., 2,000,000 galls.

Stand-Pipe.—Cap., 80,000 galls.; 11 ft. in diam. by 115 ft. high.

Distribution.—*Mains*, 10 to 4-in., material not given, 10 miles. *Taps*, 280. *Meters*, not given. *Hydrants*, Perkins, 55.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $96,729. Capital stock, $100,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., withheld, but est., $4,500. Ann. rev.: consumers, withheld, but est., $8,000; city, $3,500 for 55 hydrants, or $63 each.

Management.—Prest., P. B. Perkins. Supt., W. H. Allen.

FULTON, *Callaway Co.* (Pop., 2,409; est., 4,000.) Manufactures earthenware and fire-clay brick.

☞ **History.**—Begun in '88 and to be put in operation in fall of '89. Engr., Jas. Leach. Labor done by town.

Water Supply.—An 800-ft. artesian well, pumping to reservoir.

Pumping Machinery.—A 300,000-gall. deep well pump made by N. O. Nelson, and a 1,000,000-gall. duplex high-pressure Deane pump.

Reservoir.—Cap., about 650,000 galls. Probably receives water from well.

Distribution.—Not given.

Financial.—Cost, est., $20,000. Bonded debt, $80,000. Int., 6%.

Management.—Chn. Com.: W. H. Humphreys. Clerk, T. M. Bolton.

HANNIBAL, *Marion Co.* (Pop., 11,074; est., 19,000.) On Mississippi river Engaged in river and other trade, and manufacturing. Incorp. a city in '45.

History.—Built in '79-80 by Hannibal Water Co., under a 20 years' franchise. Des. and Consulting Engr., Chas. A. Smith, St. Louis. Const. Engr., Thos. N. Boutelle. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Mississippi river, pumping to reservoir. Water was originally taken from the river about ¾ miles above the city, passing through screen and filter wells, to a combined settling and pump well.

Intake.—A 16-in. cast iron pipe, 6 ft. below the surface, extended 165 ft. into the river. At the shore there was a well provided with copper screens of ¼-in. mesh, through which water passed, and was then conveyed to a filter well through 200 ft of 16-in. cast iron pipe laid in a tunnel.

Filter Well.—Here water passed through 3 ft. of sponge and 2 ft. of sand, gravel and charcoal, before reaching the main well. In '80 the filter had a dy. cap. of 300,000 galls. Provision was made for taking water directly from the river.

Settling Well and Pump-Well.—Is 40 ft. in diam. at the top, 38 at the bottom, 30 ft. deep, with its bottom 10 ft. below low water.

Pumping Machinery.—Dy. cap., 4,000,000 galls.; a 1,500,000-gall. duplex Blake pump, and a 2,500,000-gall. Allis pump.

Reservoir.—Cap., 1,500,000 galls.; has semicircular ends, and is 122 by 194 ft. at the top, 68 by 140 ft. at the bottom, 210 ft. above the city, 230 ft. above low water, and 1,000 ft. from the pumping station. The inlet and outlet pipes enter the reservoir from the same side, each joint being encased with stone walls, and the space between filled with clay puddle.

Distribution.—*Mains*, c. i., 14 miles. *Services*, lead. *Taps*, 750. *Meters*, 31. *Hydrants*, Mathews, 92.

Consumption, 500,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 125 lbs.

Financial.—Cost, $128,000. Debt. $105,000. Int., 8%. Ann. op. exp., $5,700. Ann. rev.: consumers, withheld, but est., $15,000; city, $5,000. Hydrant rental, $66.66 each for 75.

Management.—Prest., J. G. Chapman. Secy. and Treas., Horatio D. Wood. Supt., Chas. T. Lewis.

HOLDEN, *Johnson Co.* (Pop., 2,014; est. 4,500.)

History.—Built in '87 by Holden Water-Works Co., under a 20 years' franchise, with privilege of renewal unless city buys works. Engrs., L. P. Andrews and J. B. Quigley. Contrs., Inter-State Gas & Water-Works Co., St. Louis.

Water Suplply.—Impounding reservoir, pumping through filter to stand-pipe.

Reservoir.—Not described.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; duplex compound Deane pumps, and steel boilers.

Filters.—Hyatt, dy. cap., 200,000 galls.

Stand-Pipe.—Cap., about 75,000 galls.: 10 ft. in diam. by 127 ft. high. Made by Jno. O'Brien & Co., St. Louis.

Distribution.—*Mains*, c. i., 6¼ miles. *Services*, galv. i., lead. Pipe and specials from South St. Louis Foundry. *Taps*, 46. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 110,000 galls. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, not given, but est. $75,000. Capital stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., not given, but est., $3,500. Ann. rev.: consumers, est., $4,000; city, $3,000. Hydrant rental, $60 each.

Management.—Prest., L. P. Andrews. Secy., A. Schenk. Supt., B. J. Miller. Report by S. F. Rosse.

INDEPENDENCE, *Jackson Co.* (Pop., 3,146; est., 6,000.) On Missouri river, 1,027 ft. above the sea. Has various manufactories. Settled in '27.

History.—Built in '84-3 by Independence Water Co., under a 20 years' franchise. Engr. and Contr., P. B. Perkins, Springfield, Mo.

Water Supply.—Missouri river, pumping to reservoir. [As described in *Engineering News*, vol. XIII, page, 157, water was pumped to a reservoir 30 ft. above the river, in two compartments, one serving as a settling basin and the other for storage with filter of sand enclosed by masonry walls between them. Water was then repumped to another reservoir, 390 ft. above the first, and from this repumped to the tank described below, there being four pumps in all. The report for '88 mentions but one reservoir and one 500,000-gall. pump, as given below.—Ed.]

Pumping Machinery.—A 500,000-gall. Smith & Vaile pump.

Reservoir.—Is 60 by 130 ft.

Tank.—Cap., 60,000 galls.; of wood, 24 by 18 ft., on 45-ft. brick tower.

Distribution.—*Mains*, c. i., 8½ miles. *Services*, w. i., lead. Pipe and specials bought of Ripley & Bronson, St. Louis, Mo. *Taps*, 250. *Meters*, none. *Hydrants*, Chapman, 50. *Valves*, Chapman.

Consumption, 800,000 galls. *Pressure*: Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, $90,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $3,000; city, $4,000. Hydrant rental, $80 each.

Management.—Prest., W. E. Winner. Secy., C. S. Crysler. Supt., R. D. Wirt.

JEFFERSON BARRACKS, *St Louis Co.* (Pop., 700.) A military post near St. Louis.

General Description.—Built in '88 by U. S. Government. Engr., Thos. J. Whitman. Contrs., Jno. Patrick O'Donnell, all of St. Louis. A 6-in. main leads from the St. Louis water-works to the distribution system at the post. Cost, $10,725. Other details not given. Report by Deputy Qr. M. Genl. U. S. A., St. Louis, Mo.

JEFFERSON CITY, *Cole Co.* (Pop., 5,271; est., 7,000.) On Missouri river in timber and mining district.

History.—Built in '88 by private company, under 20 years' franchise granted to P. B. Perkins, No. Springfield, Mo.

Water Supply.—Missouri river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 2,500,000 galls.

Stand-Pipe.—Is 15 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, 14 to 4-in. c. i., 7 miles. *Hydrants*, 70.

Financial—Est. cost, $60,000 to $75,000.

Management.—Address P. B. Perkins, No. Springfield, Mo. Geo. W. Winston, City Clerk.

NOTE:—Most of the above is taken from the water-works ordinance, and may be subject to change. No other information could be obtained.

JOPLIN, *Jasper Co.* (Pop., 7,038; est., 10,000.) On uneven ground in lead and zinc mining region. Has manufactories. Settled in '71; incorp., in '73.

History.—Built in '80 by Joplin Water Co., under a 20 years' franchise. Des. Engr., P. B. Perkins, Springfield, Mo.

Water Supply.—Shoal creek, pumping to reservoir. The creek is 3¾ miles distant and rises 50 miles away in the Ozark Mts.

Pumping Machinery.—An 864,000-gall. Smith & Vaile pump, lifting water 220 ft

Reservoir.—Cap., 3,000,000 galls.; in embankment, lined with stone in cement, 82½ ft. above the city.

Distribution.—*Mains*, c. i., 13 miles. *Services*, w. i., lead. *Taps*, 650. *Meters*, 8 *Hydrants*, Ludlow, 60.

Consumption, 450,000 galls. *Pressure*: Ordinary, 30 to 60 lbs. Fire, 100 lbs.

Financial.—Cost, $124,000. Capital stock, $124,000. Bonded debt, $75,000. Int., 7%. Ann. op. exp., $5,300. Ann. rev.: consumers, $9,905; city, $5,000. Hydrant rental, $83.33.

Management.—Thos. Connor. V. Prest., L. Briggs. Supt., C. W. Glover.

KANSAS CITY, *Jackson Co.* (Pop., 55,785; est., 110,000.) Est. pop. supplied, 130,000.) At junction of Kansas and Missouri rivers, on bottom land, undulating land rising back of this which varies in elevation from 75 to 260 ft. At the south Turkey creek empties into the Kansas river, forming the natural sewer outlet for the city.

Kansas City, Kan., joins the city on the south and west. This municipality now includes old Kansas City, Wyandotte, Armstrong, River View, and Armourdale all Kansas towns, and all but the first being between the two rivers.

History.—Built in '73, when the population was about 40,000, by the National Water-Works Co. Later the system was extended to Kansas City, Kan., under a 20 years franchise granted to the Kansas City Water Co., of Kansas, the management of the two companies being the same. Since '84 the franchises and plant of the Wyandotte Armourdale Water Co. has been secured by the National Water-Works Co. In '86-7 important extensions and improvements were made by the latter company. Galen W. Pearsons, Kansas City, has been Des. and Const. Engr. since the works were arted. The labor has been done by the company.

The old works at Wyandotte were built in '84 by the Wyandotte Water Co., under a 20 years' franchise and soon extended to Armourdale under a similar franchise granted to the Armourdale Water Co. Later the two companies were merged in one. The Wyandotte plant has been connected with the new works but will be used only in emergency.

Water Supply.—Missouri river, mainly by direct pumping. Water is first pumped to Quindaro settling basins and flows thence by gravity to a tank at the intermediate Kaw point pumping station and to the original pumping station at Turkey creek. The Kaw point station is auxiliary to the first or Turkey creek plant and supplies Kansas City, Kan., by pumping from the tank back to the old Wyandotte stand-pipe, and also fills the lower levels of Kansas City, Mo., by direct pumping and also the old reservoir on the hill in Kansas City, Mo., thus leaving the full capacity of the first plant for the high service supply of Kansas City, Mo. When the Kaw point pumps draw so heavily upon the supply as to diminish the gravity flow to the Turkey creek station this is accelerated by pumping. The basins constructed at Turkey creek station for settling purposes are now used for storage, and water is pumped from them directly to the mains for high service.

The supply was taken from the Kansas river at the Turkey creek station until the completion of the new pumping works built in '86-7.

THE QUINDARO WORKS.

Intake Crib.—Located at a point above Wyandotte, and east of Quindaro, where the shore has a protection put in by the U. S. Government, consisting of willow mattress and riprap extending from the top of the banks to nearly the full depth of the stream, being about 150 ft. wide and reaching a depth of 15 ft. at low water. In constructing the crib the riprap was cleared away and a grillage sunk to conform with the surface of the mattress, the grillage forming the bottom of the inlet crib, and timber work of oak and yellow pine being built up from this to within 2 ft. of low water mark. The remainder of the crib is of heavy masonry, the wells containing gates and screens to admit water from any height.

Siphon.—Leads from inlet crib to pump-well, 745 ft., and is of 42-in. pipe, the first 75 ft. from the river being of wrought iron, and the remainder of cast iron with lead joints. The center of the siphon is 10 ft. above low water, most of the rise being at the river and for the remaining distance but 6 ft. in 100. The soil is alluvial, and the bottom of the trench was made 6 ft. wide, then cross-planked.

Pumps.—Two sets of Holly-Gaskill pumps, with a dy. cap., of 18,000,000 galls., lift water to the settling basins.

Settling Basins.—Cap., 60,000,000 galls. Four basins in embankment on alluvial bottom land, which is 27 ft. above datum. The top of the banks is 50 ft. above datum. One end is straight, the other semi-circular. The outer slopes are 1½ to 1, and the inner, 2 to 1. The outer bank is 74 ft. thick at the bottom, of heavy clay from adjacent bluffs.

The river side of the basins is guarded with riprap, and the others have slight retaining walls. The bottom of the basins is covered with 2 ft. of clay, put down in thin layers, dragged and rolled, and upon this and the inner slopes of the banks was placed a layer of concrete, topped with a smooth coat of cement. The concrete is 4 in. thick on the bottom and 5 on the slopes. The interior walls are of masonry, on a grillage of 8 by 10-in. timbers, 14 ft. long, spaced 10 in. apart, and laid on 10 by 10-in. longitudinal timbers, the whole bedded in concrete. In each of the interior walls, and in a part of the east or straight bank are two 3 by 6½-ft. conduits, through which water flows from one basin to another. The bottom of the center basin has a slope of 10%; of the others, from 5 to 3%. The depth of water varies from 20 to 30 ft., except at the east end of the center basin, which is shallower, the inlet discharging in the center of this, and spreading over its bottom.

Conduit.—A 36-in. pipe, with a dy. cap. of 16,000,000 galls., leads to the Kaw point station and beyond this to the old station at Turkey creek.

KAW POINT WORKS.

Receiving Tank.—Cap., 320,000 galls.; 50 ft. in diam. and 27 ft. deep.

Pumping Machinery.—Cap., not given. Worthington duplex compound condensing pump, with 25 and 43.3 in. steam cylinders and 26-in. water plunger, all o 48-in. stroke. There are four 200 H. P. Heine safety boilers.

Wyandotte Stand-Pipe.—Cap., 350,000 galls.; 25 ft. in diam. and 100 ft. high.

River Crossing.—Two pipes are carried across Kansas river on a bridge. The pipe also crosses a bridge at the Turkey creek station.

Reservoir.—Cap., 2,000,000 galls.; 232 ft. above the river, and 330 by 380 ft. at the water surface, by 25 ft. deep. In excavation and embankment, with concrete on the bottom and half way up the slopes, the upper portion paved with limestone 12 to 20 in. thick.

TURKEY CREEK WORKS.

Reservoir.—Originally built for a settling basin with a cap. of 7,000,000 galls., and afterwards enlarged to 18,000,000 galls. Since the completion of the new pumping plant this has been used as a storage and receiving reservoir, from which water is pumped directly to the mains for the high service in Kansas City.

Pumping Machinery.—The first pumps here were 10-in. Holly quadruplex of 30-in. stroke. To these were added a 5,000,000-gall. Holly quadruplex and an 8,000,000-gall. set of low-lift pumps. The present pumps are not described, but they are either of the Holly or Worthington type.

The remaining data applies to the whole system, including Kansas City, Kan.

Distribution.—*Mains*, c. i., 85 miles. *Services*, galv. i., lead. *Taps*, 7,786. *Meters*, 950. *Hydrants*, Holly, Mathews, Ludlow, 852. *Pressure-recording gauge*, Edson.

Consumption, 10,000,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 130 lbs.

Financial.—Cost, $4,500,000. Capital stock, $3,000,000. Bonded debt, $3,000,000. Int., 6%. Ann. op. exp., $56,283. Ann. rev.: total, $392,761. Hydrant rental, $40, $60 and $80.

Management.—Prest., Geo. E. Taintor. Secy. and Treas., R. N. Weems. Both of 102 Broadway, New York City. Cashier, Geo. B. Wing. Supt., B. F. Jones. Asst. Fred Wing. Chf. Engr., F. E. Sickles.

NOTE:—An extended description of these works, with illustrations, is given in *Engineering News*, vol. 18, pp. 328-9, 345-6, 380, 400, 437, 454-5. These articles were written by Galen W. Pearsons, who was Des. and Const. Engr. of the works. This description includes some parts of the old works not now in use, especially the first intake syphon and pump-well.

LEXINGTON,* *LaFayette Co.* (Pop., 3,096; est., 5,000.) On Missouri river, in coal region, upon a high bluff. Engaged in manufacturing and trade.

History.—Built in '84-5 by Lexington Water Co., under a 20 years' franchise. Const. Engr., Jos. Simmons. Contr., J. A. Jones.

Water Supply.—Missouri river, pumping to settling reservoirs, then repumping to tank.

Pumping Machinery.—Two 1,500,000-gall. Blake pumps, for pumping and repumping, and two Root's safety boilers.

Settling Reservoirs.—Two, ½ mile from river, under the bluff, and near the pump.

Stand-Pipe.—Cap., 300,000 galls.: 18 ft. in diam. by 152 ft. high. Built by E. E. Palmer & Son, Kansas City.

It is unofficially reported that one stand-pipe burst just after its erection, when full of water. This was said to be on six 50-ft. cast-iron columns, the pipe being 22 ft. in. diam. and 152 ft. high.

Distribution.—*Mains*, spiral riveted w. i., 7 miles. *Services*, galv. i., lead. *Taps*, 290. *Meters*, Crown, 15. *Hydrants*, White, 50.

Consumption, 150,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $90,000. Capital stock, $100,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, about $4,000; city, $4,000. Hydrant rental, $80.

Management.—Prest., Wm. Morrison. Secy. and Treas., Jas. Wentworth. Supt., Jos. A. Edmonds.

MARSHALL, *Saline Co.* (Pop., 2,701; est., 4,500.)

History.—Built in '85 by Marshall Water Co., under a 20 years' franchise. Engr., P. B. Perkins.

Water Supply.—Well, 30 ft. in diam., by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls; Worthington pumps, and 35 H. P. tubular boilers.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. Contrs. for pipe and specials.

and laying same, National Water-Works Co. *Taps*, 100. *Meters*, none. *Hydrants*, Ludlow, 67. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $75,000. Capital stock, $75,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $2,400. Ann. rev.: consumers, $2,000; city, $5,025. Hydrant rental, $75.

Management.—Prest., Jno. R. Hall. Secy., C. L. Hall. Supt., E. R. Davis.

MARYVILLE, *Nodaway Co.* (Pop., 3,485; est., 5,000.)

History.—Built in '86 by Municipal Investment Co., under an exclusive 20 years' franchise. Engr. and Contr., A. H. McCormick, Parsons, Kan.

Water Supply.—One Hundred and Two river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls., make not given. Two 80 H. P. boilers.

Stand-Pipe.—Cap., about 250,000 galls.; 18½ ft. in diam by 135 ft. high.

Distribution.—*Mains*, c. i., 8 miles. *Services*, galv. i. *Taps*, 120. *Meters*, 27. *Hydrants*, White, 51. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure*: Ordinary, 55 lbs.

Financial.—Cost, $80,000. Bonded debt, $75,000. Int., 6%. Ann. op. exp., $1,440. Ann. rev.: consumers, $1,682; city, $3,468. Hydrant rental, $68.

Management.—Prest., Wm. O. Cole. V. Prest., Chas. H. Coffin. Supt. and Secy., C. P. Denny.

MEXICO, *Audrain Co.* (Pop., 3,835; est., 7,000.) On Salt river. Manufactures plows and wagons.

History.—Built in '84-5 by Mexico, Mo., Water-Works Co., under a 20 years' franchise. Des. Engr., C. S. Masten, Phœnix, Ariz. Const. Engr., W. C. Masten. Contrs., Pond & Masten.

Water Supply.—Springs and surface water, by direct pumping.

Pumping Machinery.—Dy. cap., 1,750,000 galls.; Blake pumps, and tubular boilers, bought of Pond Engineering Co., St. Louis.

Distribution.—*Mains*, c. i., 4.8 miles. *Services*, galv. i., lead. *Taps*, 200. *Meters*, 4. *Hydrants*, Chapman, 45. *Valves*, Chapman.

Consumption, 250,000. *Pressure*: Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—Cost, $80,000. Capital stock, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $3,000. Ann. rev.: consumers, $3,600; city, $3,600. Hydrant rental, $80.

Management.—Prest., W. C. Masten, Kansas City. V. Prest., Frank H. Pond, St. Louis. Supt., Secy. and Treas., E. R. Cunningham.

MOBERLY, *Randolph Co.* (Pop., 6,070; est., 10,000.)

History.—Built in '85 by Moberly Water-Works Co., under a 20 years' franchise.

Water Supply.—Surface water, by direct pumping from reservoir.

Dam.—Forms reservoir. Not described.

Reservoir.—Covers 27 acres, and has a depth of 33 ft. at dam.

Pumping Machinery.—Dy. cap., 1,300,000 galls.; two Worthington pumps, and two 4 by 14-ft. tubular boilers.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, lead. *Taps*, 260. *Meters*, 4. *Hydrants*, Chapman, 70.

Consumption, 400,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 130 lbs.

Financial.—Cost, $125,000. Capital stock, $20,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., $3,758. Ann. rev.: consumers, $4,528; city pays int. on bonds, $6,000, for hydrant rental, or $85.71 each.

NEVADA, *Vernon Co.* (Pop., 1,913; est., 9,000.)

History.—Built in '85 by Nevada Water Co., under a 20 years' franchise.

Water Supply.—Marmaton river, pumping to reservoir.

Pumping Machinery.—Deane pumps, dy. cap., 2,000,000 galls.

Reservoir.—Is 150 ft. sq.

Distribution.—*Mains*, c. i., 10 miles. *Services*, w. i. *Taps*, 500. *Meters*, not given. *Hydrants*, kind not given, 66.

Consumption, not given. *Pressure*: Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost, $77,000. Capital stock, $100,000. Bonded debt, $30,000. Int., not given. Ann. op. exp., withheld, but est., $4,000. Ann. rev.: consumers, withheld, but est., $12,000; city, $3,300. Hydrant rental, $50.

Management.—Prest. C. H. Malin. Supt., C. B. Ingels.

RICH HILL, *Bates Co.* (Pop., est., 6,000.) On prairie. Engaged in coal mining and zinc smelting. Settled in '80.

History.—Built in '83 by private company, under a 20 years' franchise. Engr., F. Wm. Raeder, St. Louis.

Water Supply.—Marais des Cynges river, through Hyatt filter to well, thence by direct pumping.

Filter.—Hyatt, dy. cap., 1,000,000-galls.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. duplex pumps, and Jarvis boilers, all bought of Pond Engineering Co., St. Louis.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, w. i. *Taps*, 170. *Meters*, 8. *Hydrants*, Ludlow, 50. *Valves*, Ludlow.

Consumption, 300,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 90 lbs.

Financial.—Cost, $100,000. Bonded debt, $100,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $8,400; city, $4,500.

Management.—Prest., D. E. Garrison. V. Prest., O. L. Garrison. Both of St. Louis. Supt. and Secy., E. A. Slater.

SAINT CHARLES, *St. Charles Co.* (Pop., 5,014; est., 7,500.) On Missouri river, the business portion lying on a plateau about 15 ft. above high water, 400 to 500 ft. wide, back of which ground rises about 200 ft. in 1¼ miles. The difference between high and low water is about 40 ft. Settled about 1760.

History.—Built in '81 by St. Charles Water & Heating Co., under a 20 years' franchise. Des. Engr., Chas. A. Smith, St. Louis. Const. Engr., J. T. Jones. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Missouri river, pumping to settling tanks, thence by re-pumping to tank and direct.

Intake Pipe.—Of 12-in. pipe, from a point in the river 8 ft. below low water, to the pump-well. The first 200 ft. is of perforated wrought iron pipe with flanged joints, and the remaining 600 ft. of cast-iron.

Pump-Well.—Masonry, 25 ft. sq. and 30 ft. deep from surface of bank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Worthington pumps. These are (probably) used for repumping, as in '82 a 2,000,000-gall. Knowles-Cornish pump lifted water from the well to the settling tanks. The steam cylinders were at the surface and the water cylinders at the bottom of the well.

Settling Tanks.—Cap., 860 000 galls.; two, of plate iron, each 70 ft. in diam. by 15 ft. deep, set on a masonry bed 80 by 160 ft., on the edge of the bank, 10 ft. above high water.

Distributing Tank.—Cap., 200,000 galls. In '82 a circular wooden tank was in use; this was 20 ft. in diam. by 16 ft. high, on a brick tower 25 ft. sq. and 40 ft. high, built on a hill back of the city, the water level in the tank being 318 ft. above low water in the city. The bottom of the tank was placed on timber trussed beams, and further supported by a timber trestle built in the center of the tower. The trestle was not a part of the original design. All timber was treated by the Thilmany process, and hot paraffine applied to the brickwork.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, iron. *Taps*, 275. *Meters*, 1. *Hydrants*, Ludlow, 40. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure*: Ordinary, 87 lbs. Fire, 120 lbs.

Financial.—Cost, $80,000. Capital stock, $80,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $3,240. Ann. rev.: consumers, $1,000; city, $3,600. Hydrant rental, $90.

Management.—Prest., E. Richards. Supt., W. L. Vick.

SAINT JOSEPH, *Buchanan Co.* (Pop., 32,431; est., 78,000.) On Missouri river on bottom land, the bluff at this point being about five miles from the river. Settled in '43; incorp. a city in '50.

History.—Built in '80 by St. Joseph Water Co., under 20 years' franchise and hydrant contract. Engr., Jno. W. Rutherfoord, New York City. Masonry and building constructed by city.

Water Supply.—Missouri river, pumping to reservoir. The point from which the supply is taken is three miles from the city, by land, and 10 miles by water, owing to a bend in the river.

Pumping Machinery—Dy. cap., 8,000,000 galls.: two 3,500,000 and 1,000,000-gall. horizontal duplex compound condensing Worthington pumps.

Force Main.—In '82 this was a 16-in. cast-iron pipe, 1,196 ft. long, rising 320 ft. between the pumps and reservoir.

Reservoir.—Cap., 22,000,000 galls.; in two compartments, in excavation and embankment, with inner slopes lined with one course of brick laid on 18-in. of puddle. Water settles in the first basin, then passes to the second.

Supply Main.—Of 20-in. cast-iron, 2¼ miles long.

Distribution.—*Mains*, 24 to 4-in., c. i., 32 miles. *Services*, lead. Pipe and specials from Cincinnati & Newport Iron & Pipe Co., Newport, Ky. *Taps*, not given. *Meters*, Crown, number not given. *Hydrants*, Mathews, 250. *Valves*, Ludlow.

Consumption, not given. *Pressure*: 70 to 115 lbs., according to elevation.

Financial—Cost, not given. Capital stock, $400,000. Bonded debt, $400,000; $300,000 at 6% and $100 000 at 10%. Ann. op. exp., withheld, but est., $20,000. Ann. rev.: consumers, for '85, $80,000; city, $21,400. Hydrant rental, $100 each for 160, and $60 for additional.

Management.—Prest., Jas. M. Barnes. Secy., L. C. Barnes. Supt., T. J. Chew, Jr.

SAINT LOUIS, *St. Louis Co.* (Pop., 350,518; est., 450,000.) On Mississippi river, covering an area of over 60 sq. m. and having about 13 miles of river frontage. The ground rises from the river quite rapidly, and the valley of Mill creek divides the city into two parts, the northern rising 140 and the southern 155 ft. above the river. Founded in 1764; incorp. a city in '22.

General History.—Owned by city. First works built in '30. New works begun in '65 and different parts finished in '73 and '83. An extension of the low service estimated to cost from $3,000,000 to $4,000,000 was begun in '88. The works built in '65-72 were designed by Jas. P. Kirkwood, with Col. Henry Flad, now Prest. Board Public Works, as principal assistant.

THE WORKS FROM '30 TO '65.

Water Supply.—Mississippi river, pumping to reservoir.

Intake Pipe.—The first was of cast-iron, with hub and spigot joints. In '48 this drew apart, and was replaced by a pipe with flanged joints, bolted. It was located at the foot of Bates St.

Pumping Machinery.—The first consisted of a high-pressure engine of 17-in cylinder and a pump of 13½-in. bore, both of 72-in. stroke. In '46 an engine with a 20-in. cylinder, driving a 16-in. pump, both of 96-in. stroke, was added. The first pump lifted water 60, and the second 140 ft. In '52, '56, '61 and '68 new pumping engines were added. Their dimensions are given in *Engineering News*, vol. VIII., p. 142. The first two pumping engines were removed in '57, the fifth replaced the fourth, and in '71 the three remaining were sold.

Reservoirs.—The first was built in '30, of brick and stone, 60 ft. above the river, near the engine house, and on Broadway. In a few years it became filled with sediment, and a wooden tank was built upon it. This was used till '49, when a reservoir was built on Howard St., 6,000 ft. from the pumps and 120 ft. above the river. It was 250 ft. sq. by 25 ft. deep, with masonry walls.

In '53, 4 ft. of sediment was removed from this reservoir, taking 11 days, and costing $2,167.

In '55 a reservoir was built adjoining the above, 237 by 527 ft., by 47½ ft. deep. The walls were of rubble masonry, the inner sides lined with brick, the outer strengthened by 44 buttresses, connected with the walls by elliptical arches of 16-ft. span and 4-ft. versed sines. An earth embankment, placed against the walls, was finished in '61. Meanwhile the brick walls often cracked and leaked, the leaks generally becoming stopped by sediment.

Sediment in Old Reservoirs.—The first and second reservoirs filled with sediment, and were abandoned. In '58, three years after its construction, the third reservoir had 12 ft. of sediment, and in '60 the outlet pipe was covered so that a 17-ft. vertical addition was made. In '62 the solid deposit was 14.33 ft. deep, with 2¼ ft. of soft slush above this, and in '67 the deposit was 30 ft. deep, the rate of accumulation for the 13 years being about 2¼ ft. a year. It then became necessary to build a supplementary reservoir for use until the new works were finished. This reservoir was not cleaned until '80, when a flume 6,000 ft. long was built and jets of water used to cut the deposit and wash it to some low grounds near the river. The cost of removing the deposit was 12 cents per cu. yd. Work was continued for 100 days, when winter set in, 30,000 cu. yds. being removed in that time, and 110,000 remaining. It is not stated whether the process was continued.

THE PRESENT WORKS.

Water Supply.—Mississippi river, pumping to settling basins, thence re-pumped through stand-pipes and distribution system to reservoir.

Intake Cylinder.—Of cast-iron, sunk in river to bed rock, and provided with screens so water can be taken at any depth. Generally water is taken 5 ft. below the surface, where it has been found to be freest from floating impurities, and from sediment near the bottom.

Intake-Pipe.—Is 66 in. in diam.

Pump-Well.—Of masonry, built on coarse unyielding sand, which is confined by sheet piling, driven 12 ft. below the bottom of the well, or 25 ft. below the lowest water level in the river. The well is near the river, and the bank at this point is covered with riprap.

Pumping Machinery.—Divided into high and low, and temporary low service, the first low service lifting water to the settling basins, and the high service re-pumping. Water is lifted from 15 to 50 ft., according to the stage of the river, and the cap. of the pumps depends upon the condition of the water.

Low Service: Dy. cap., 49,000,000 galls.; two 16,000,000-gall. Cornish bull, and one 17,000,000-gall. beam and fly-wheel double plunger pumping engines.

Temporary Low Service: Dy. cap., 20,000,000 galls.; four 5,000,000-gall. duplex non-condensing Worthington pumps.

High Service: Dy. cap., 63,000,000 galls.; three 15,000,000-gall. single, and one 18,000,000-gall. double compound beam and fly-wheel pumping engines. A large high-pressure beam engine was built in '88 by the Fulton Iron Works, St. Louis, but it is not stated whether this is one of the above.

Settling Basin.—Cap., about 100,000,000 galls. Located 365 ft. from the engine house. Four basins, each 278 by 600 ft., by 19 ft. deep. Sides lined with squared stone range masonry, 9 ft. thick at the bottom and 4 at the top, reinforced every 7 ft. by 3 by 4 ft.-buttresses.

These walls rest on foundations of timber and concrete, so distributed that the load shall not exceed 200 lbs. per sq. ft., as the soil is the loose alluvium of the river bottom. The walls are backed with puddling. The partition walls are 11 ft. thick at the bottom and 8 at the top. The bottom is paved with brick on edge, and slopes toward the center and the river.

One basin is drawn from while two are settling and another filling, or one settling and another being cleaned. Each basin is cleaned about once in four months, in which time about 16 in. of sediment has been collected. In '78, 184,000 cu. yds. were taken from the basins at a cost of $.0105 per cu. yd., and in '79, 140,000 at $.0084.

Conduits, clear water well, screen chamber and pump-well: A brick conduit 1,100 ft. long leads to a well 100 by 300 ft., by 17 ft. deep, from which an 8 by 13-ft. brick conduit leads to a screen chamber, 9 by 50 ft. From the latter three 60-in. pipe lead to the pump in a dry well, 12 by 87 ft., and 39 ft. below the high service engine-house floor.

Stand-Pipes.—Two. No. 1 being 5 ft. in diam. and No. 2 6 ft., and both 160 ft high.

Reservoir.—Cap., 60,000,000 galls. Is 540 by 870 ft. at water surface, by 22 ft. deep. Embankments are puddled in the center and faced with 16-in. of dry stone wall on 8 in. of broken stone. The bottom is covered with 6 in. of concrete on 2 ft. of puddle. The full water level is 170 ft. above the city directrix, or base of levels, which is 33.83 ft. above the low water of Dec., '63, and 7.58 ft. below the high water of June, '44.

Distribution.—*Mains*, c. i., 315 miles. *Services*, lead. Pipe and specials for extensions from Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and South St. Louis Foundry. *Taps*, 34,022. *Meters*, (in '86,) 2,143. *Hydrants*, 3,161 public, and 36 private. Hydrants and valves are of special designs, hydrants on extension being made by St. Louis Iron and Machine works, and stop valves by Fulton Iron Works, St. Louis.

Consumption, 31,500,000 galls. *Pressure*: Average, 40 lbs.

Financial.—Cost, about $13,000,000. Debt, $5,200,000. Int., 6%. Ann. op. exp., $270,000. Ann. rev: consumers, $920,000; city, none.

From May, '30, to May, '67, when the works passed into hands of commissioners, the works cost $2,421,070, and the rev. had been $2,096, 278. On the completion of the new works in '71, the old works, and their operation, had cost $2,980,000, and the rev. had been $3,780,000.

Management.—Prest. Board Public Works, Col. Henry Flad. Water Comr., M. L. Holman. Assessor and Collector, Jos. Temple. Chf. Mech. Engr., Aug. W. Grote. Asst. Engr. in charge of distribution, S. B. Russell. Asst. Mech. Engr., Ed. Flad.

References.—For account of "Lowering a Large Main while in use," by S. Bent Russell, see *Engineering News*, vol. XIII., p. 241, and for cuts of engine known as High Service No. 5, and specifications for same, see same journal, vol. XVI., pp. 84 and 93.

SEDALIA, *Pettis Co.* (Pop., 9,561; est., 22,500.) On high rolling prairie. Engaged in manufacturing. Settled in '60; incorp. a city in '64.

History.—Built in '71 by city; sold in '87 to Sedalia Water-Works Co., who immediately rebuilt the works. Engr. for latter work, J. B. Quigley; Contrs., Inter-State Gas & Water-Works Co. All of St. Louis.

WORKS PRIOR TO '87.

General Description.—Water was pumped from Spring Creek directly to the mains, and to a tank, by a gang of six upright 12-in. Holly pumps, with two rotary Holly pumps for fire protection. *Dam*: Built across creek in '82; 160 ft. long, forming a 60,000,000-gall. storage reservoir. *Tank*: At highest part of city, 153 ft. above pumps; 40 ft. in diam. by 20 ft. high, on 40 ft. trestle.

PRESENT WORKS.

Water Supply.—Flat river and Spring creek, pumping to stand-pipes.

Pumping Machinery.—Dy. cap., 9,500,000 galls.; Deane and Blake pumps, and steel boilers.

Filter.—Hyatt.

Stand-Pipes.—Cap., about 160,000 each; two, 15 ft. in diam. by 125 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis.

Distribution.—*Mains*, c. i., 21 miles. *Services*, galv. i., lead. Pipe and specials from Shickle, Harrison and Howard Iron Co. and South St. Louis Foundry Co. *Taps*, withheld. *Meters*, 10. *Hydrants*, Mathews, 155. *Valves*, Chapman.

Consumption, 1,200,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $400,000. Capital stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., withheld, but est., $10,000. Ann. rev.: consumers, withheld, but est., $25,000; city, $9,300. Hydrant rental, $60.

Management.—Prest., J. B. Quigley. V. Prest. and Treas., Theo. Platt. Secy., A. Schenck. Supt., S. F. Rosse.

SPRINGFIELD, *Greene Co.* (Pop., 6,522; est., 30,000.) Springfield and North Springfield were consolidated in '87.

History.—Built in '83 by Springfield Water Co., under a 20 years' franchise. Engr., P. B. Perkins, Springfield. Labor done by company.

Water Supply.—Surface water, or Little See river, pumping to reservoirs, tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Deane duplex, Chapman and Perkins. Water was formerly re-pumped from one of the reservoirs to the tank. It is not stated whether this is still done.

Reservoirs.—Cap., 4,000,000 and 1,500,000 galls., respectively. The first 256 by 322 ft., by 14 ft. deep, in earth embankment, lined with brick. It is 53 ft. above and 3½ miles from the city.

Tank.—Cap., 65,000 galls.; is 60 ft. above the first reservoir, and 113 ft. above the city.

Distribution.—*Mains*, c. i., 30 miles. *Services*, w. i., lead. *Taps*, about 1,200. *Meters*, 6. *Hydrants*, kind not given, 155.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $375,107. Capital stock, $300,000. Debt, $246,000; $200,000 6% bonds, and $46,000 floating debt at 8%. Ann. op. exp., $9,200. Ann. rev.: consumers, $20,900; city, $11,000. Hydrant rental, 76 at $78.95, and 79 at $63.29.

Management.—Prest., P. B. Perkins. V. Prest., Jno. Francis. Secy., Chas. Brooks. Mgr., W. C. Hornbeak. Supt., A. H. Robertson.

TRENTON, *Grundy Co.* (Pop., 3,312; est., 5,500.) On Grand river.

History.—Built in '86 by Trenton Water Co. Engr., W. A. Fritts.

Water Supply.—Grand river and well close by, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Smith & Valle pumps, and boilers from Fairbanks & Co., St. Louis.

Stand-Pipe.—Cap., about 170,000 galls.; 15 ft. in diam. by 130 ft. high. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 10 to 6-in. c. i., 5 miles. *Services*, not given. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 250. *Meters*, Crown. Worthington, 20. *Hydrants*, Holly, 50.

Consumption, 110,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—Cost, $92,000. Capital stock, $75,000. Debt, $80,000. Int., 6%. Ann. op. exp., $2,500. Ann. rev.: consumers, $5,000; city, $2,000. Hydrant rental, $40.

Management.—Prest., W. H. Taylor, New York City. V. Prest. and Supt., W. A. Fritts. C. A. Conrads.

WASHINGTON, *Franklin Co.* (Pop., 2,421; est., 6,000.) On Missouri river.

History.—Built in '88-9 by Washington Water & Light Co. The franchise is owned by the Inter-State Gas & Water-Works Co., of St. Louis, and was for 20 years. Engr., L. P. Andrews, St. Louis.

Water Supply.—Missouri river, pumping to filter and clear water reservoir, thence by repumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; two 1,000,000-gall. compound duplex Buffalo pumps. Pumps and boilers from Pond Engineering Co., St. Louis.

Filter.—Hyatt.

Clear Water Reservoir.—Cap., 400,000 galls.; has earth embankments 12 ft. high and a masonry division wall 40 ft. long, 12 ft. high, 5 ft. thick at the bottom and 2 at the top.

Stand-Pipe.—Cap., 100,000 galls.; 12 ft. in diam. by 125 ft. high. From M. M. Leckie, Joplin, Mo.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. *Services*, lead, iron. Pipe and specials from Ripley & Bronson, St. Louis, and trenching and pipe-laying done by Jno. Maxwell, Kansas City. *Meters*, Worthington, number not given. *Hydrants* Holly-Gaskill, 50. *Valves*, Holly.

Pressure: from stand-pipe, 60 to 90 lbs.

Financial.—Cost, $60,000. Capital stock, authorized, $80,000. Bonded debt, $50,000. Int., 6%. Hydrant rental $60.,

Management.—Local company not organized. Of Inter-State Gas & Water-Works Co.: Prest., Theo. Plate; V. Prest. and Engr., L. P. Andrews; Secy., A. Schenck.

Water-Works Projected with Fair Prospects of Construction.

LAMAR, *Barlan Co.* (Pop., est., 3,000.) Manufactures flour and farming implements.

Proposed System.—In '88 the Lamar Gas & Water Co. proposed to pump water from all artesian well to a stand-pipe. Est., cost, $30,000. Prest., L. D. Mison, work was to be begun in July. No later information given. Report by E. H. Adams.

NEOSHO, *Newton Co.* (Pop., est., 3,500.) Engaged in manufacturing.

Proposed System.—In '88 the city was anxious to grant a franchise for a stand-pipe system. Supply to be taken from springs near the town. Address, J. E. Alexander or A. M. Ballou. Report by L. D. Bell, Mayor.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Alton, *Oregon Co.*; Appleton City, *St. Claire Co.*; Bolivar, *Polk Co.*; Butler, *Bates Co.*; Cartersville, *Jasper Co.*; Columbia, *Boone Co.*; Kirkwood, *St. Louis Co.*; Lebanon, *Laclede Co.*; Macon, *Macon Co.*

ARKANSAS.

Water-Works Completed or in Process of Construction.

ALEXANDER, *Pulaski Co.* (Pop., est., 200.)

History.—Built in '88 by Alexander Water Co., principally for benefit of stockholders.

Water Supply.—Springs, by gravity to tank.

Tank.—Cap., about 8,000 galls.

Distribution.—*Mains*, 1¼-in. iron, 1,440 ft. *Taps*, "but few." *Meters*, none.

Financial.—Cost, $250. Capital stock, $300. No debt.

Management.—Prest., Esten Peloubet. Treas., T. J. Rolffe. Secy., A. B. Holland. Supt., T.H. Bevey.

CAMDEN, *Ouachita Co.* (Pop., 1,503; est., 3,000.) On Ouachita river.

History.—Built in '89 by Camden Water-Works Co., work beginning Jan. 15. Engr., Thos. V. Hall. Contrs., J. Walker Bates & Co., New York City.

Water Supply.—Ouachita river. The original plans called for direct pumping, but it is officially reported that a stand-pipe will probably be erected.

Pumping Machinery and Stand-Pipe.—Not described.

Distribution.—*Mains*, c. i., 1½ miles at first.

Financial.—Cost, est., $20,000. Capital stock, $16,000.

Management.—Prest., S. Q. Sevier. Secy. and Treas., T. J. Ganghan.

FORT SMITH, *Sebastian Co.* (Pop., 3,099; est., 20,000.) On Arkansas river on undulating ground. Has large cotton compress and cotton-seed mills. Founded in '38.

History.—Built in '84 by Fort Smith Water Co. The franchise runs 20 years from Oct., '87. Des. Engr., Chas. McRitchie, Chicago, Ill. Const. Engr., A.L. Pogue, Richmond, Ind.

Water Supply.—Poteau river, filtered, pumping to reservoir. The river is a mountain stream.

Filter.—Of sand and gravel, 20 ft. sq., built around the inlet pipe leading to pump-well.

Pumping Machinery.—Dy. cap., 5,500,000 galls. The first pumps were Smith & Vaile. Three boilers with a total of 255 H. P.

Reservoir.—Cap., 6,000,000 galls. Is 110 ft. above city level.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead, iron. *Taps*, 700. *Meters*, 5. *Hydrants*, Chapman, 67. *Valves*, Chapman.

Consumption, 700,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 85 lbs.

Financial.—Cost, $236,000. Capital stock, $200,000. Bonded debt, $125,000. Int., not given. Ann. op. exp., $3,700. Ann. rev.: consumers, $15,100; city, $3,850. Hydrant rental, $60 each for 50, and $50 for additional.

Management.—Prest., Jno. Vaile. Treas., G. N. Pogue. Secy., N. Winn. Supt., E. A. Thomas.

HOPE, *Hempstead Co.* (Pop., 1,233; est., 2,200.) Has some manufactories.

History.—Built in '85 by town, under direction of Council.

Water Supply.—Artesian well, 1,100 ft. deep, pumping to tank.

Pumping Machinery.—Knowles upright pump.

Tank.—Cap., about 60,000 galls.; 22 ft. in diam. by 22 ft. deep.

Distribution.—*Mains*, w. i., 6 miles. *Services*, w.i. *Taps*, 350. *Meters*, not given. *Hydrants*, kind not given, 6.

Consumption, not given. *Pressure*; 17 lbs.

Financial—Cost, $15,000. No debt. Ann. op. exp., about $700. Ann. rev.: consumers, not given, est., $1,500.

Management.—Council. Chn., J.R. Jones. Report by D.S. Ferguson.

HOT SPRINGS, *Garland Co.* (Pop., 3,554; est., 12,000.) On mountain stream in valley between Sugar Loaf and Hot Springs mountains, of the Ozark range. Has mining interests. A famous health resort. Settled in 20; incorp. a city in '74.

History.—Built in '82 by Hot Springs Water Co., under a 50 years' exclusive franchise. Contr., Carroll E. Gray, Jr. Chicago, Ill.

Water Supply.—Bull Bayou, pumping to distributing reservoir. The Bayou receives the drainage from about ½ sq. m. of mountain slopes. Cap., about 100,000,000.

Dam.—Of masonry, across a narrow gorge in the rocks to form the above, or increase the storage capacity.

Conduit.—Of stone, 5 ft. high and 40 ft. long, leading from dam to pump.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a duplex compound Worthington, and a duplex compound condensing Knowles pump. Return tubular boilers.

Reservoir.—Cap., 1,000,000 galls.; excavated in rock on mountain, 262 ft. above main street of town.

Distribution.—*Mains*, c. i., 9 miles. *Services*, w. i., lead. *Taps*, 250. *Meters*, 50. *Hydrants*, Holyoke, 51. *Valves*, Ludlow.

Consumption, 400,900 galls. *Pressure*: 115 lbs.

Financial.—Cost, $150,000. Capital stock, $80,000. Bonded debt, $100,000. Int., 6%. Ann. op. exp., withheld, but est., $4,500. Ann. rev.: consumers, withheld, but est., $7,000; city, $5,100. Hydrant rental, $100 each.

Management.—Prest., A. B. Gaines. Supt., A. N. Sill.

LITTLE ROCK, *Pulaski Co.*. (Pop., 13,138; est., 35,000.) On Arkansas river on rolling ground, the rocky bluff from which the city derives its name being 50 ft. high. Settled in '20.

History.—Built in '78 by private company, and now owned by Home Water company, and Arkansas Water Co., the latter having put in a new pumping plant and reservoir in 87-8 to increase the supply and facilities of the old company. Franchise runs for 25 years, city having privilege of buying works on one year's notice after expiration of 10 years. Contr. for original works, Travers Daniels; for late extensions and improvements, Zeb Ward.

Water Supply.—Arkansas river, pumping to stand-pipe and to reservoir. The reservoirs were built with the new works.

Pumping Machinery.—Dy. cap., $8,250,000 galls.; Blake pumps, the old ones having a cap. of 2,500,000, and the new of 6,000,000 galls. Boilers made by Jno. O'Brien, St. Louis, Mo.

Stand-Pipe.—Cap., about 230 000 galls.; 20 ft. in diam. by 100 ft. high, on ground 65 ft. above the river.

Reservoir.—Cap., 18,000,000 galls.: in two compartments, one of which serves as a settling basin. Is 150 ft. wide at each end, 180 ft. at the partition wall, and 600 ft. long. Built of stone quarried from the reservoir site. The reservoir is 250 ft. above the city. It is unofficially reported that on Nov. 2, '87, but two hours before the new works were to be tested, the division wall gave way, a part of the contents pouring down the hill. The wall was 35 ft. high, 12½ ft. thick at the bottom and 6 ft. at the top. The wall was laid in cement mortar and had a cement lining.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis. *Taps*, 1,044. *Meters*, 15. *Hydrants*, Chapman, 104. *Valves*, Chapman,

Consumption, 2,000,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $430,000; $180,000 for old works, and $250,000 for new. Capital stock, $32,500. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $9,000. Ann. rev.: consumers, $28,255; city, $8,565. Hydrant rental, about $80.

Management.—Prest., Zeb Ward. Supt., Secy. and Treas., Zeb Ward, Jr.

NEWPORT, *Jackson Co.* (Pop., 683; est., 3,000.) On White river. Engaged in manufacturing.

History.—Built in '86-7 by Newport Irrigation & Water Co. Engr., A. H. McCormick, who owns franchise.

Water Supply.—White river, pumping to tank.

Pumping Machinery.—Combined dy. cap., 2,000,000 galls.; two Smith & Vaile duplex pumps, and two horizontal tubular boilers. Contrs., Fairbanks & Co., St. Louis, Mo.

Tank.—Cap., 68,000 galls. Is 24 ft. in diam., 20 ft. high, placed on a tower 126 ft. high.

Distribution.—*Mains*, c. i., 3¼ miles. *Services*, lead, galv. and black i. *Taps*, 60. *Meters*, 17. *Hydrants*, Nelson, 52. *Valves*, Nelson.

Consumption, 20,000 galls. *Pressure*: Ordinary, 54 lbs. Fire, 54 to 200 lbs.

Financial.—Cost, $51,000. Capital stock, $100,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, $840; city, $1,285.

Management.—Prest., A. H. McCormick, Parsons, Kansas. Supt., A. G. Harper.

PINE BLUFF *Jackson Co.* (Pop., 3,203; est., 16,000.) On Arkansas river.

History.—Built in '88, and now owned by Pine Bluff Water & Light Co. The franchise is for 30 years, and was originally granted to, and works were partially built by the Water, Light & Power Co., St. Louis, Mo., who turned them over to the present owners. Engr. for former company, F. Wm. Raeder, St. Louis, Mo.; for latter, Wm. Barclay Parsons, New York City.

Water Supply.—Well and Arkansas river, pumping direct and to stand-pipe.

Pumping Machinery.—Combined dy. cap., 3,500,000 galls. Two Buffalo pumps, furnished by Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 85,000 galls.: 10 by 150 ft.

Distribution.—*Mains*, 14 to 4-in. c. i., 10 miles. *Services*, galv. i., lead. *Taps*, not given. *Meters*, Crown. *Hydrants*, Chapman, 160. *Valves*, Eddy.

Consumption, not given. *Pressure*; Ordinary, 80 lbs. Fire, 140 lbs.

Financial.—Cost, $150,000. Capital stock, $300,000. Bonded debt, $125,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $30,000, including that from electric lights; city, $8,000. Hydrant rental, $43.

Management.—Prest., J. F. Thompson, Elmira, N. Y. Secy., F. L. Greene. Supt., W. P. Thompson.

ROGERS, *Washington Co.* (Pop., 1,788.) Engaged in manufacturing.

History.—Built in '88 by Rogers Lime & Water Co. Engr. and Contr., P. B. Perkins, Springfield, Mo.

Water Supply.—Spring, pumping to tank. The spring has a dy. cap. of 876,330 galls., and is 2,600 ft. east of town.

Tank.— Cap., 45,000 galls.; 22 ft. in diam. by 16 ft. high, and 175 ft. above spring. On brick tower, 23½ ft. in diam. at base, and 21½ ft. at top, 45 ft. high, with walls 3 ft. at bottom and 16 in. at top. The tank rests on a cast-iron plate placed on 16 wooden beams, each 6 by 12 in. radiating from a pine column 12 in. sq., braced to masonry.

Pumping Machinery.—Cap., not given. One duplex pump, 12 and 7 in. in diam. and 12-in. stroke, from Hughes, Cleveland, O. Locomotive boiler, 14 ft. long, with 10 sq. ft., of grate surface, rated at 20 H. P.; from Oil City, (Pa.) Boiler Works.

Pump House.—Is of brick, 16 by 24 ft. and 12 ft. high, near spring.

Distribution.—*Mains*, 8 to 4-in., c. i., 1.08 miles. *Taps*, not given. *Meters*, not given. *Hydrants*, kind not given, 8. *Valves*, kind, do.

Consumption, 125,500 galls. *Pressure*, not given.

Financial.—Cost, $9,517.44. Capital stock, $1,200. Debt, not given. Ann. op exp., not determined. Ann. rev.: consumers, not determined; city, $200.

Management.—Prest., J. W. Frey. Secy., Geo. Raupt.

NOTE:—Prof. J. M. Whitham, Rogers, Ark., read a paper on these works at the second annual meeting of the Ark. Soc. of Engrs., Architects & Surveyors, at Little Rock, Nov. 22-4, '88.

TEXARKANA, *Miller Co.* (Pop., 3,223; est., 10,000.) Engaged in manufacturing and lumbering.

History.—Built in '87 by Texarkana Water Co., under a 30 years' franchise. Const. Engr., Louis Metesser, New Orleans, La. Labor done by company and local contractors.

Water Supply.—Ten flowing Wagner wells, 40 ft. deep, by pumping. There is a reservoir, but the report does not state whether it is for receiving or distributing purposes.

Reservoir.—Cap., 3,000,000 galls.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Gordon & Maxwell pumps, and Heine safety boilers.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, w. i., lead. *Taps*, 110. *Meters*, 1. *Hydrants*, Chapman, 28. *Valves*, Chapman.

Consumption, 600,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 130 lbs.

Financial.—Cost, $64,000. Capital stock, $60,000. Bonded debt, $60,000. Int., 6%. Ann. op. exp., $800. Ann. rev.: total, $11,400. Hydrant rental, $100 each for 20, and $75 for additional.

Management.—J. A. Polhomius. Secy., F. M. Polhomius. Supt., E. N. Maxwell.

NOTE:—A paper on these works was read by A. B. Watson, at the second annual meeting of the Ark. Soc. of Engrs., Architects and Surveyors, at Little Rock, Nov. 22-4, '88.

Water-Works Projected with Fair Prospects of Construction.

HELENA, *Phillips Co.* (Pop., est., 5,500.) On Mississippi river. Engaged in manufacturing.

Proposed System.—In Dec., '88, J. W. Terry, of St. Louis, made proposition to city to put in works. This was favorably received, but no action had been taken at time of report. City Engr., F. J. Rickon.

LONOKE, *Lonoke Co.* (Pop., est., 2,000.)

Proposed System.—In '88 the city proposed to build water-works at a cost not to exceed $2,000. D. Daniels is Chn. Water Board.

Water-Works Projects Reported in '87 and '88, but now Indefinite.

Batesville. *Independence Co.*; Marianna, *Lee Co.*; Monticello, *Drew Co.*; Morrillton, *Conway Co.*; Nashville, *Howard Co.*; Van Buren, *Crawford Co.*

TEXAS.

Water-Works Completed or in Process of Construction.

ABILENE, *Taylor Co.* (Pop., est., 3,500.) Has some manufactories.

History.—Built in '85-6 by a private company, and bought by town in '87. Des. Engr., —— Groscup. Contrs., Groscup & Keith.

Water Supply.—Wells and Lytle creek, pumping to stand-pipe or direct.

Pumping Machinery.—Dy. cap., 720,000 galls.; two 360,000-gall. Blake duplex pumps and two 3½ by 14-ft. tubular boilers. All bought of Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 70,000 galls.; 12 by 85 ft. Contr., ——Hamilton, of Galveston.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. Pipe and specials from Shickle Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 85. *Meters*, none. *Hydrants*, kind not given. 35.

Consumption, 60,000 galls. *Pressure*: 65 lbs.

Financial.—Cost, $42,500. Debt, $32,500. Int., 8%. Ann. op. exp., $2,400. Ann. rev.; consumers, not given but est., $2,500.

Management.—Council. Pumping Engr., Jno. Purtell. Report by D. W. Winsten.

AUSTIN, *Travis Co.* (Pop., 10,960; est., 27,000.) On Colorado river, about 650 ft. above the sea. Engaged in manufacturing.

History.—Built in '75 by private company after plans by W. R. Freeman. Rebuilt in '82 with M. C. Orton as Des. Engr. In '87 the Austin Water, Light and Power Co. was organized, and they now own the works.

Water Supply.—Colorado river, by direct pumping.

Pumping Machinery.—In '84 a 3,000,000-gall. Holly quadruplex, and a 2,000,000-gall. Worthington duplex pump were used.

Distribution.—*Mains*, c. i., 21 miles. Services, not given. *Taps*, (in '84,) 1,100. *Meters*, (in '84,) 75. *Hydrants*, kind not given, 166.

Consumption, for '83, about 1,000,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 140 lbs.

Financial.—*For* '83. Cost, $350,000. Capital stock, $350,000. Bonded debt, $340,000. Int., 7%. Ann. op. exp., not given, but est., $10,000. Ann. rev.; consumers, $36,500. Hydrant rental, $100 each for 100, and $50 for additional.

Management.—Prest., M. D. Mather. Secy., D. L. Wickes. Supt., R. L. Wicks.

NOTE:—Requests for information have been practically ignored since '84.

BEAUMONT, *Jefferson Co.* (Pop., est., 3,500.) On Neches river. Engaged in manufacturing.

History.—Built in '88 by city. Engrs. and Contrs., Thomas & Gorman, Houston, Tex.

Water Supply.—Neches river, pumping to stand-pipe.

Pumping Machinery.—Cap., 1,000,000 galls.; duplex pump and return tubular boilers.

Stand-Pipe.—Cap., 102,000 galls.; 12 ft. in diam. by 120 ft. high.

Distribution.—*Mains*, c. i., 3½ miles. *Taps*, not given. *Meters*, not given. *Hydrants*, kind not given, 41.

Financial.—Cost, $24,000. Bonded debt $10,000; running 30 years. Int., 6%.

Management.—Not given. Report by W. E. Thomas.

BELTON, *Bell Co.* (Pop., 1,797; est., 5,000.) On Leon river. Has manufactories. Settled in '44; incorp. a town since.

History.—Built in '84 by town, and now leased and operated by Matthew Dow. Engr., Michael L. Lynch, Galveston. Contr., W. C. Connor, Dallas.

Water Supply.—Leon river, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Worthington pumps.

Stand-Pipe.—Cap., about 200,000 galls.; plate iron, 20 ft. in diam. by 86 ft. high, on hill 123 ft. above pumps, 80 ft. above public square, midway between and about one mile from each.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 400. *Meters*, 1. *Hydrants*, kind not given, 28.

Consumption, 100,000 galls. *Pressure*: Ordinary, 70 lbs. Fire, 140 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 6%. Ann. op. exp., $3,500. Ann. rev.: consumers, $5,000: city, none.

Management.—Lessee and Mgr., Matthew Dow.

BRENHAM, *Washington Co.* (Pop., 4,101; est., 7,500.)

History.—Built in '85 by private company under a 25 years franchise.

Water Supply.—Springs, pumping to stand-pipe.

Pumping Machinery.—A 1,500,000-gall. Deane compound duplex pump, and Wiggan & Simpson boiler.

Stand-Pipe.—Cap., 110,000 galls.; 14 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i., galv. i. *Taps*, 150. *Meters*, 3. *Hydrants*, from Wiggan & Simpson, 35.

Consumption, 75,000. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $65,000. Debt, $60,000. Int., 6%. Ann. op. exp., $2 000. Ann. rev.: consumers, $4,500; city, $1,750. Hydrant rental, $50.

Management—Prest., F. A. Engelke. Secy., J. N. Brown. Supt. and Pumping Engr., J. H. Ledlie.

BROWNWOOD, *Brown Co.* (Pop., 725; est., 3,500.)

History.—Built in '86-7 by town. Des. Engr., M. L. Lynch, Galveston. Contrs., R. D. Wood & Co., Philadelphia, Pa. Sub-contrs. for pipe-laying, Thomas & Storrie, Dallas.

Water Supply.—Natural reservoir in bed of Pecan Bayou, two miles from court house, pumping to stand-pipe.

Pumping Machinery.—Two compound duplex Worthington pumps; dy. cap., 2,400,000 galls.: two 40 H. P. steel tubular boilers.

Stand-Pipe.—Cap., about 220,000 galls.; 20 ft. in diam. by 100 ft. high. Furnished by Contrs.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles. *Services*, not given. *Taps*, 68. *Meters*, none. *Hydrants*, Mathews, 37. *Valves*, Eddy.

Consumption, 50,000 galls. *Pressure*: Ordinary, 46 lbs. Fire, 120 lbs.

Financial.—Cost, $46,000. Debt, $46,000, of which $26,000 is in bonds. Int., 6%. Ann. op. exp., $800. Ann. rev.: consumers, not given, but est., $1,700; city, none.

Management.—Council. Secy., Ed. Smith. Supt., Brooke Smith.

CALVERT, *Robertson Co.* (Pop., 2,28; est., 3,500.) Engaged in manufacturing.

History.—Built in '87-8 by Calvert Water, Ice and Electric Light Co., under a 25 years' franchise. Des. Engr., T. M. Jones. Const. Engr., L. T. Fuller. Contrs., Gorman & Re nkie, Dallas, Texas.

Water Supply.—Artesian wells, pumping to stand pipe and reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls. One Smith & Vaile and one Knowles pump: Atlas boilers.

Stand-Pipe.—Cap., 85,000 galls.; 12 by 100 ft. From Ripley & Bronson, St. Louis.

Reservoir.—Cap., 30,000 galls. Not described.

Distribution.—*Mains*, c. i., 5½ miles; from Ripley & Bronson. *Taps*, 120. *Meters*, kind not given, 30. *Hydrants*, kind not given, 11.

Consumption, 40,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 150 lbs.

Financial.—Cost, $17,500. Capital stock, $16,000. Bonded debt, $9,000. Int., 8%. Ann. op. exp., $1,000. Ann. rev.: consumers, est., $2,000; city, est., $825.

Management.—Prest. and Supt., L. T. Fuller. Secy. and Treas., J. A. Foster.

CASTROVILLE, *Medina Co.* (Pop., 731; est., 1,000.)

History.—Built in '87 or '88 by J. Courand, who was Des. Engr.

Water Supply.—Stream, pumping to tank.

Pumping Machinery.—Cap., 50,000 galls. Rotary pump, make not given.

Tank.—Cap., 10,000 galls. Not described.

Distribution.—*Mains*, w. i.

Management.—Supt., T. M. Courand.

NOTE:—No further information given.

CLEBURNE, *Johnson Co.* (Pop., 1,855; est., 8,000.) On a high rolling prairie, between Brazos and Trinity rivers.

History.—Built in '83-4 by town. Des. Engr., D. C. Heron. Contr., W. Brown.

Water Supply.—Springs, pumping to tank and direct. Vitrified drain-pipe collects water from several springs and conducts it to the pump-well.

Pump-Well.—Is 26 ft. in diam. and depth, walled in and covered with brick in cement.

Pumping Machinery.—Dy. cap., not given; two Worthington pumps, one a compound duplex of 16-in. steam and 10¼-in. water cylinders, and the other of 16 and 10-in. steam and 8¾-in. water cylinders, all of 10-in. stroke.

Tank.—Cap., about 60,000 galls.; 20 ft. in diam. by 25 ft. high, on brick tower 51½ high, with walls 2 ft. thick, the bottom of the tank resting on rolled iron beams.

Distribution.—*Mains*, Kalamein i., 5 miles. *Services*, not given. *Taps*, 225. *Meters*, none. *Hydrants*, kind not given, 31.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 200 lbs.

Financial.—Cost, $51,000. Debt, $51,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5 000; city, none.

Management.—Supt., Jno. Mitchell. Pumping Engr., D. S. Whittenburg.

COLORADO, *Mitchell Co.* (Pop., est., 2,000.) On Colorado river. Manufactures salt.

History.—Built in '85 by town, and leased and operated by Caldwell & Fletcher. Engr., J. M. Barrett. Labor done by the city and local contractors.

Water Supply.—Wells, pumping to stand-pipe.

Pumping Machinery.—Knowles pumps, dy. cap., 1,500,000 galls.

Stand-Pipe.—Cap., 285,000 galls.; 22 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. Pipe and specials from L. M. Rumsey & Co., St. Louis, Mo. *Taps*, 200. *Meters*, 3?. *Hydrants*, kind not given, 16.

Consumption, about 700,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 80 lbs.

Financial.—Cost, $56,000. Debt, $56,000, of which $53,000 is bonds. Int., 6%. Ann. op. exp., $2,400. Ann. rev.: consumers, $2 500; city, $500.

Management.—Council. Lessees, Caldwell & Fletcher.

COLUMBUS, *Colorado Co.* (Pop., 1,959; est., 3,000.) On Colorado river.

History.—Built in '84 by town. Des. Engr., G. C. Stevens. Const. Engr. and Contr., J. T. Jones.

Water Supply.—Colorado river, pumping to tank and direct.

Pumping Machinery.—A 350,000-gall. duplex Blake pump of 12 in. steam and 7-in. water cylinders of 12-in. stroke.

Tank.—Cap., 52,000 galls.; iron, 20 ft. in diam. by 22 ft. high, on 60 ft. brick tower, having walls 2½ ft. thick at base with slight batter. Is 110 ft. above pump. A wooden tank was formerly used. Tank proper from King Iron Bridge Co., Cleveland, O.

Distribution.—*Mains*, 6 and 4-in. c. i., 2¼ miles. *Services*, w. i. *Taps*, 75. *Meters*, none. *Hydrants*, Bailey, 9. *Valves*, Chapman.

Consumption, 12,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 100 lbs.

Financial.—Cost, $28,000. Bonded debt, $25,000. Int., 8%. Ann. op. exp., $500. Ann. rev.: consumers, $700; city, none.

Management.—Supt., J. J. Montgomery. Pumping Engr., Jacob J. Dick. Report by the latter and D. Steiner.

CORSICANA, *Navarro Co.* (Pop., 3,373; est., 10,000.) On rolling prairie land.

History.—Built in '84 by Corsicana Water Co., under a 25 years' franchise. Des. Engr., G. C. Heron.

Water Supply.—Lake, pumping to stand-pipe. The lake has an area of 115 acres.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. Worthington pumps, and Atlas boilers.

Stand-Pipe.—Cap., 230,000 galls.; 20 ft. in diam. by 100 ft. high, on a hill 45 ft. above surrounding land.

Distribution.—*Mains*, Kalamein i., 10 miles. *Services*, galv. i. *Taps*, 500. *Meters*, 50. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 55 lbs. Fire, 150 lbs.

Financial.—Cost, $200,000. Capital stock, $75,000. Bonded debt, $130,000: $80,000 at first and $50,000 at second issue. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $15,000; city, $5,500. Hydrant rental, $100 each.

Management.—Prest., Saml. R. Frost. V. Prest. and Secy., Bryan T. Barry. Supt., D. C. Barry.

DALLAS, *Dallas Co.* (Pop., 10,358; est., 45,000.) On Trinity river, just below mouth of Elm fork, on bluff 25 to 30 ft. above high water. Settled in '41; incorp. a town in '44.

History.—Built in '76 by city, after plans by Travers Daniels, and rebuilt in '84 by Chester B. Davis, Chicago, Ill. In '88 large reservoirs were built and other improvements made: Des. Engr., J. D. Cook, Toledo, O. Const. Engr. R. W. Harris. Contrs., McRae, Lally & Son, Detroit, Mich.

Water Supply.—Trinity river and springs, pumping to reservoir and stand-pipe. Originally water was pumped to stand-pipe from a well 32 by 80 ft., sunk in coarse gravel, and connected with the river by 500 ft. of 12-in. iron pipe.

Pumping Machinery.—Dy. cap., 13,000,000 galls.; Worthington and Holly pump. Two small Knowles pumps were used until they became insufficient. Boilers from J. Wanzler, St. Louis, Mo.

Reservoirs.—Cap., about 100,000,000 galls.; two, or in two basins. They serve both settling and storage purposes, have an area of 20 acres, and a depth of 20 ft.

Stand-Pipe.—Cap., about 150,000 galls.: 15 ft. in diam. by 116 ft. high. Made by Thomas & Storrie, Dallas.

Distribution.—*Mains*, c. i., 25 miles. *Services*, w. i. Pipe and specials, lately, from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 1,500. *Meters*, none. *Hydrants*, Ludlow, Chapman, Mathews, 140.

Consumption, 2,225,000 galls. *Pressure*: Ordinary, 50 lbs.

Financial.—Cost, $350,000. Bonded debt, $300,000. Int., 5 and 6%. Ann. rev.: consumers, $35,000; city, $4,000.

Management.—Chn. Com., L. S. Garrison. Supt., Dave Tichenor.

DECATUR, *Wise Co.* (Pop., 579; est., 3,000.)

General Description.—Built in '83 by A. R. Whitehead, and enlarged in '89. A 72,000-gall. Cook deep-well pump lifts water to a 36,000-gall. tank. *Mains*, 3-in., extending throughout village.

DEL RIO, *Val Verde Co.* (Pop., est., 1,800.)

History.—Built in '83, by S. P. R. R. Co. Engr., M. J. Converse, San Antonio

Water Supply.—Springs, pumping to tank.

Pumping Machinery.—Deane pump, cap. not given.

Tank.—Cap., 10,000 galls.

Distribution.—*Mains*, 4 and 2-in. c. i., 10 miles. *Taps*, 130. *Meters*, 1. *Hydrants* 20.

Consumption, 75,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 160 lbs.

Financial.—Ann. op. exp., $2,400. Ann. rev.: consumers, $2,600.

Management.—C. C. Gibbs, Houston, Texas. Supt., Fred. Crowley.

NOTE.—No other information given.

DENISON, *Grayson Co.* (Pop., 3,975; est., 15,000.)

History.—Built in '86-7 by Denison City Water Co., under 20 years' franchise. Engr., E. F. Fuller. Contrs., Saml. R. Bullock's Co. Both of New York City.

Water Supply.—Wells and surface water, the latter impounded in a reservoir, pumping to stand-pipe.

Pumping Machinery.—Dy. cap., 3,000,000 galls.: two compound condensing Holly-Gaskill pumps.

Stand-Pipe.—Cap., about 160,000 galls.; 15 ft. in diam. by 125 ft. high. Built by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. Pipe and specials from Shickle, Harrison & Howard Iron Co. *Taps*, 375. *Meters*, 38. *Hydrants*, Holly, 75.

Consumption, not determined. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $240,000. Capital stock, $200,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $4,100. Ann. rev.: consumers, $8,120; city, $7,500. Hydrant rental, $100.

Management.—Prest., D. W. Duryea. Treas., E. W. Abendroth. Secy., E. Woltmann, 11 Wall St., New York City. Supt., Given W. Bradley.

EAST DALLAS, *Dallas Co.* (Pop., est., 4,000.)

History.—Built in '86 by East Dallas Water Supply Co., under 50 years' franchise.

Water Supply.—Well, pumping to stand-pipe. The well is 36 ft. in diam. by 25 ft. deep.

Pumping Machinery.—A 500,000-gall. Deane pump.

Stand-Pipe.—Cap., about 110,000 galls.; 14 ft. in diam. and 100 ft. high.

Distribution.—*Mains*, c. i., 3½ miles. *Services*, galv. i. *Taps*, 110. *Meters*, 3. *Hydrants*, Chapman, 15. *Valves*, Chapman.

Consumption, 200,000 galls. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,000; city, $450. Hydrant rental, $30; to be increased.

Management.—Prest. and Supt., T. J. Oliver. Secy., T. L. Morsalis.

EL PASO, *El Paso Co.* (Pop., 736; est., 10,600.) On Rio Grande river in dry, sandy valley. Settled in '27; incorp. a village in '53, a city in '78.

History.—Built in '82 by El Paso Water Co., under a 25 years' franchise. Engr. and Contr., Sylvester Watts, St. Louis, Mo.

Water Supply.—Rio Grande river, pumping to reservoirs.

Dam.—Built to divert water into ditches for irrigating purposes. Size and character not given.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; Gordon & Maxwell, and Smith & Vaile pumps, and four tubular boilers.

Reservoirs.—Cap., 6,000,000 galls.; three, serving for settling and distributing purposes, their elevation above the city being from 200 to 180 ft.

Distribution.—*Mains*, w. i., kalamein i., 8 miles. *Services*, w. i. Pipe and specials from Chattanooga (Tenn.) Foundry & Pipe Works. *Taps*, 800. *Meters*, 400. *Hydrants*, White, 41. *Valves*, Ludlow.

Consumption, 400,000 galls. *Pressure*: 74 lbs.

Financial.—Cost, $80,000. Capital stock, $20,000. Bonded debt, $20,000. Int., 6%. Ann. op. exp., $13,500. Ann. rev.: consumers, $24,000; city, $3,460. Hydrant rental, $100 each for 25, and $60 each for additional.

Management.—Prest., J. W. Parker. Supt., W. H. Watts.

FORT WORTH, *Tarrant Co.* (Pop., 6,663; est., 30,000.) At junction of Trinity and Clear Fork rivers on rolling prairie land.

History.—Built in '82-3 by private company, and now owned by city. Engr., M. C. Orton. Contrs., Drake & Orton, New York City. Later work has been done with H. McLoughlin as Des. Engr.

Water Supply.—Trinity river, Clear creek and gang wells, by direct pumping. The gang well system was adopted in '88, Mr. F. O. Brown contracting to put down 95 2-in. wells, 24 ft. deep, in the gravel bed under the river. These are about 9 ft. apart, on each side of and 3 ft. from the main suction pipe. There is a receiving or settling well. A detailed description of the wells is given in *Engineering News*, vol. XVIII., p. 396. Formerly water was taken from the river, through two wells, 20 ft. sq. and 16 ft. deep, sunk in its gravel bed.

Receiving Reservoir.—In connection with the wells; 30 by 150 ft.

Pumping Machinery.—Holly pump, dy. cap., 4,000,000 galls.

Distribution.—*Mains*, c. i., 23 miles. *Services*, w. i. *Taps*, 1,500. *Meters*, 50. *Hydrants*, Holly, 126. *Valves*, Ludlow.

Consumption, 4,000,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 120 lbs.

Financial.—Cost, $261,000. Bonded debt, $200,000. Int., 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, $29,485; city, $6,300. Hydrant rental, $50.

Management.—Chn. Com., F. J. Latum. Mgr., M. H. Hilburn. City Clerk, Henry R. Early.

GAINESVILLE, *Cooke Co.* (Pop., 2,667; est., 10,000.)

History.—Built in '83-4 by Gainesville Water Co., under a 50 years' franchise.

Water Supply.—Elm river, by direct pumping.

Reservoir.—Cap., 115,000,000 galls. [Probably formed by dam across river.]

Pumping Machinery.—Holly pumps, dy. cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 8,4 miles. *Services*, w. i. *Taps*, 400. *Meters*, 103. *Hydrants*, Ludlow. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $188,000. Capital stock, $200,000. Bonded debt, $160,000. Int.,

6%. Ann. op. exp., $5,850. Ann. rev.; consumers, $7,062; city, $6,400. Hydrant rental, $100 each for 100, and $50 for each additional.

Management.—Prest., J. S. Drake. Secy., H. B. Fletcher. No Supt.

GALVESTON, *Galveston Co.* (Pop., 22,248; est., 40,000.) On island at mouth of Galveston bay.

GALVESTON WATER CO.'S WORKS.

General Description.—Built in '84, taking supply from artesian wells, by pumping through cast-iron pipe. No further information can be obtained.

CITY'S WORKS.

History.—Built in '88-9. Engr., J. D. Cook. Contr. for masonry and buildings, L. B. Stevens. Both of Toledo, O. Supt. of Const., Jno. A. Cotter.

Water Supply.—Artesian wells, pumping to stand-pipe and storage tank. A contract for ten artesian wells, to have an aggregate yield of 2,000,000 galls., was let to Louis Siegel, New York City, in '88, and some of the wells finished in that year.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; two 3,000,000-gall. compound condensing Knowles pumps, and four 5½ by 16-ft. return tubular boilers. Boilers from Union Iron Works, Chattanooga, Tenn.

Tank.—Cap., 1,177,500 galls.; 100 ft. in diam. by 20 ft. deep.

Stand-Pipe.—Cap., 485,000 galls.; 25 ft. in diam. and 150 ft. high. Built by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, c. i., 33 miles; from R. D. Wood & Co., Philadelphia, Pa. Trenching and pipe-laying done by H. Merigold, Lima, O. *Hydrants*, Mathews, 350. *Valves*, Eddy. *Valve boxes*, Bingham & Taylor, Buffalo, N. Y.

Financial.—Cost, est., $450,000. Bonded debt, est., $450,000. Int., 5%.

Management.—Five Comrs. Prest., Albert Weis. Secy., Danl. J. Buckley. Supt., Jno. A. Cotter.

GEORGETOWN, *Williamson Co.* (Pop., 1,354; est., 3,500.) On San Gabriel river.

History.—Built in '84 by city, and leased to San Gabriel Water-Works Co., Des. Engr., G. C. Heron. Const. Engr., M. P. Kelley. Contrs., East Texas Water & Gas Co.

Water Supply.—San Gabriel river, pumping to stand-pipe and direct.

Pumping Machinery.—A 1,000,000-gall. Worthington pump.

Stand-Pipe.—Cap., about 230,000 galls.; 20 ft. in diam. by 100 ft. high. Made by Riter & Conley, Pittsburgh, Pa.

Distribution.—*Mains*, Kalamein i., 6¼ miles. *Services*, w. i. Pipe and specials from L. E. Rumsey Mfg. Co. *Taps*, 200. *Meters*, none. *Hydrants*, Ludlow, 120. *Valves*, Ludlow.

Consumption, 350,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $51,000. Capital stock, $15,000. Bonded debt, $14,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.; consumers, $4,500; city, none.

Management.—Prest. of Co., Emzy Taylor. V. Prest., M. P. Kelley. Secy., Lee M. Taylor. Supt., E. E. Taylor.

GONZALES, *Gonzales Co.* (Pop., 1 581; est., 2,500.) On Guadaloupe river in rolling country. Settled prior to '25; incorp. a town under Republic of Texas.

History.—Built in '84 by Gonzales Water-Works Co. Engr., T. S. Walker, Gonzales.

Water Supply.—Guadaloupe river, pumping to stand-pipe, tank and direct.

Intake.—Of cedar, 14 in. in diam. and 125 ft. long.

Pumping Machinery.—Dy. cap., 280,000 galls.; Worthington pump, and two return tubular boilers.

Stand-Pipe.—Cap., 80,000 galls.; 12 ft. in diam. by 100 ft. high. Built in '88.

Tanks.—Two, of cypress, 51 ft. above city, with cap., of 10,000 and 30,000 galls., respectively.

Distribution.—*Mains*, Kalamein i., 6 miles. *Services*, galv. i. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Consumption, 90,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 120 lbs.

Financial.—Cost, $12,000. Capital stock, $12,000. No bonds or debt. Ann. op. exp., $1,200. Ann. rev.: consumers, $3,600; city and county, $150.

Management.—Prest., C. Braches. Secy., B. H. Walker. Treas., J. M. Walker Supt., T. S. Walker.

GREENVILLE, *Hunt Co.* (Pop., est., 7,000.)

History.—Built in '88-9 by Greenville Water & Electric Light Co. Des. Engr., Chas. H. Ledlie. Conslt. Engr., Thos. J. Whitman. Res. Engr., W. W. Primm. All of St. Louis, Mo. Contrs., Laing & Co., Dallas, Tex.

Water Supply.—Cowleach fork of Sabine river, pumping from a reservoir, through filter, to stand-pipe.

Pumping Machinery.—Cap., 2,000,000 galls. Two Volker & Felthousen compound condensing plunger pumps.

Dam.—Of masonry, forming reservoir. Size not given.

Reservoir.—Cap., 105,000,000 galls.

Filter.—Not described.

Stand-Pipe.—Cap., 165,210 galls. Made by Shickle, Harrison & Howard Iron Co., St. Louis, Mo.

Distribution.—*Mains*, 15 to 6-in. c. i., 5 miles. *Taps*, not given. *Meters*, not given. *Hydrants*, Ludlow, 60. *Valves*, Ludlow.

Financial.—Capital stock, $100,000.

Management.—Prest., J. M. Cook. V. Prest., T. Howard. Secy., F. B. Nichols.

NOTE:—No other figures given.

HOUSTON, *Harrie Co.* (Pop., 16,513; est., 34,000.) On Buffalo bayou, an arm of Galveston bay, 50 miles from Galveston, on undulating land. Settled in '30.

History.—Built in '78-9 by Houston Water-Works Co.

Water Supply.—Buffalo bayou, pumping to stand-pipe and direct. It is unofficially reported that a number of artesian wells were contracted for in '88.

Pump-Well.—Is 24 ft. in diam. and depth, with pump at bottom.

Pumping Machinery.—Dy. cap., 8,000,000 galls.; a 5,000,000 and a 3,000,000-gall. pump. The first pump used was a Worthington duplex of 12-in. bore. Boilers, Heine safety.

Stand-Pipe.—Cap., about 790,000 galls.; 30 ft. in diam. by 150 ft. high. A plate iron stand-pipe 20 ft. in diam. and 88 ft. was formerly used.

Distribution.—*Mains*, c. i., 28 miles. *Services*, galv. i. *Taps*, 900. *Meters*, 12. *Hydrants*, Ludlow, 185. *Valves*, Ludlow.

Consumption, 1,750,000 galls. *Pressure*; Ordinary, 40 lbs. Fire, 90 lbs.

Financial.—Cost, $300,000. Capital stock, $150,000. Bonded debt, $150,000. Int., 6%. Ann. op. exp., withheld, but est., $37,000. Ann. rev.: consumers, withheld, but est., $40,000; city, $9,250. Hydrant rental, $50 each.

Management.—Prest., T. H. Scanlan. V. Prest. and Treas., T. W. House. Secy., T. F. White. Supt., C. H. Strong.

KYLE, *Hays Co.* (Pop., est., 1,000)

History.—Built in '87-8 by Kyle Water Co.

Water Supply.—Rio Blanco river, pumping to tanks.

Pumping Machinery.—Deane pump, dy. cap., 100,000 galls.

Tanks.—Two; cap., 31,500 galls. each.

Distribution.—*Mains*, w. i., 7 miles. *Taps*, 15. *Meters*, none. *Hydrants*, kind not given, 100.

Consumption, 25,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 48 lbs.

Financial.—Cost, $11,800. Debt, $8,000. Int., 8%. Ann. op. exp., $600. Ann. rev.: consumers, $1,200; city, $400.

Management.—Prest., H. Hellman. Secy., C. L. Sledge. Supt., J. J. Hay.

LAMPASAS, *Lampasas Co.* (Pop., 653; est., 3,500.) On Sulphur fork of Lampasas river.

History.—Built in '85 by town. Contrs., Brown & Connor, Dallas. The contract was first let to B. Van Sternberg, who failed to finish the works.

Water Supply.—Well, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,250,000 galls.; Worthington pumps and tubular boilers.

Stand-Pipe.—Cap., about 115,000 galls.; 20 ft. in diam. and 50 ft. high.

Distribution.—*Mains*, c. i., 6½ miles. *Services*, w. i. *Taps*, 165. *Meters*, none. *Hydrants*, Ludlow, 2. *Valves*, Ludlow.

Consumption, 50,0000 galls. *Pressure*: Ordinary, 40 to 50 lbs. Fire, 100 to 120 lbs.

Financial.—Cost, $40,000. Bonded debt, $40,000. Int., 7%. Ann. op. exp., $2,000 Ann. rev.: consumers, $2,700; city, not given.

Management.—Com. of three. Chf. Engr., H. E. Hedeman.

LAREDO, *Webb Co.* (Pop., 3,521; est., 8,500.) On Rio Grande river in hilly country. Settled in 1794; incorp. a village in '78.

History.—Built in '83-4 by Laredo Water Co. Engr. and Contr., W. D. Richardson, Springfield, Ill. The franchise is for 30 years', city having privilege of buying the works.

Water Supply.—Rio Grande river, filtered, by direct pumping. A 10-in. pipe originally conducted water to a settling and pump-well.

Filter Wells.—On island in river. No description given.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two compound duplex Blake pumps. and two 50 H. P. boilers.

Distribution.—*Mains*, Kalamein i., 9½ miles. *Services*, galv. i. Pipe and specials from National Tube Works Co., McKeesport, Pa. *Taps*, 327. *Meters*, none. *Hydrants*, Ludlow, 100. *Valves*. Ludlow.

Consumption, 600,000 galls. *Pressure*: Ordinary, 45 lbs. Fire. 225 to 150 lbs.

Financial.—Cost, $120,000. Capital stock, $50,000. Bonded debt, $90,000. Int., 8%. Ann. op. exp., $4,000. Ann. rev.: consumers, $10,000; city. $7,500. Hydrant rental, $75 each for first 100, and $60 each for additional.

Management.—Prest., A. L. McLane. Secy., R. Martin. Supt., A. Wagnon.

LLANO, *Llano Co.* (Pop., est., 1,000.) On Llano river.

History.—Built in '86 by W. W. Knowles & Son.

Water Supply.—Llano river, pumping to tank.

Pumping Machinery.—Cap., 25,000 galls.; water-power pump.

Tank.—Cap., 17,000 galls.

Distribution.—*Mains*, w. i., 2 miles. *Services*, w. i. *Taps*, 40. *Meters*, 1. *Hydrants*, kind not given.

Consumption, 3,000 galls. *Pressure*: Ordinary, 40 lbs.

Financial.—Cost, $2,500. No debt. Ann. op. exp., $10. Ann. rev.: consumers, $350; city, $18.

Management.—W. W. Knowles & Son.

LOCKHART, *Caldwell Co.* (Pop., 718.)

NOTE.—Address James G. Blanks for information.

MARSHALL, *Harrison Co.* (Pop., 5,624; est., 8,500.) Engaged in manufacturing.

History.—Built in '88 by city. Des. Engr., R. T. Hailey. Const. Engr., and Contr., E. Sutphin, Sherman, Tex.

Water Supply.—Wagner steamed wells, pumping to stand-pipe and direct.

Pumping Machinery.—Not described.

Stand-Pipe.—Cap., 23,203 galls.; 15 by 125 ft.

Distribution.—*Mains*, c. i., 6 miles. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 75.

Consumption, est., 1,500,000 galls.

Financial.—Cost, $80,000.

Management.—Supt., R. T. Hailey. Report by Jas. H. Carter.

NOTE.—It is unofficially stated that the original plans, as described above, have been changed since the report was made.

MEXIA, *Limestone Co.* (Pop., 1,298; est., 3,500.) Has flouring, planing and saw mills.

History.—Built in '87-8 by Mexia Water, Ice and Light Co. Engr., John R. Corley.

Water Supply.—Artificial lake, pumping to stand-pipe and direct.

Pumping Machinery.—Cap., 750,000 gall.; Smith & Vaile pumps.

Stand-Pipe.—Cap., 86,000 galls.

Distribution.—*Mains*, 6 in. c. i., 5 miles. *Taps*, 75. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, 20,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 60 to 80 lbs.

Financial.—Cost, $30,000. Capital stock, $30,000. Bonded debt, $18,500, running 40 years. Int., 6%. Ann. op. exp., $1,000. Ann. rev.: consumers, $1,500; city, $1,500. Hydrant rental, $100 each.

Management.—Prest., D. M. Prendergast. Secy. and Supt., Jno. R. Corley.

MORGAN, *Bosque Co.* (Pop., est., 700.)
History.—Built in '88 by Morgan Water-Works & Ice Co.
Water Supply.—Artesian well, pumping to tank or reservoir.
NOTE:—No other information given.

NAVASOTA, *Grimes Co.* (Pop., 1,611; est., 4,000.) On Brazos river, at mouth of Navasota river.

History.—Built in '86-8 by city, and leased for 25 years to E. L. Bridges, who was Contr. Engr., J. T. Jones.

Water Supply.—Artesian well, pumping to stand-pipe and tank.

Pumping Machinery.—Cap., 800,000 galls. One 80,000-gall. Smith & Vaile high-pressure, and one 70,000 Dean deep-well pump.

Stand-Pipe.—Cap., 58,800 galls.; 10 ft. in diam. by 100 ft. high.

Tank.—Not definitely described.

Distribution.—*Mains*, 8 to 2-in., material not given, 2½ miles. *Taps*, 35. *Meters*, none. *Hydrants*, Chapman, 12.

Consumption, 12,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 160 lbs.

Financial.—Cost, $15,000. Bonded debt, $15,000; bonds to run 50 years. Int., 6 and 8%. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,000; city, $1,200. Hydrant rental, $100 each.

Management.—E. L. Bridge, Lessee. Supt., Edward Haven.

NEW BRAUNFELS, *Comal Co.* (Pop., 1,938; est., 2,000.) On Guadaloupe river. Has some manufactories.

History.—Built in '86 by town. Des. Engr., W. W. Freeman, San Antonio. Const. Engr. and Contr., G. Gerlich, New Braunfels.

Water Supply.—Comal river, pumping to reservoir and direct.

Pumping Machinery.—A 500,000-gall. Knowles pump.

Reservoir.—Cap., 350,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. Pipe and specials from Dennis Long & Co., St. Louis, Mo. *Taps*, 123. *Meters*, none. *Hydrants*, kind not given, 28. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 24 lbs. Fire, 120 lbs.

Financial.—Cost, $20,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., $1,300. Ann. rev.: consumers, withheld, but est., $2,500.

Management.—Supt., Gustav Gerlich.

PALESTINE, *Anderson Co.* (Pop., 2,997; est., 5,000.) On a ridge, six miles from Trinity river. Settled in '30.

History.—Built in '81-2 by Palestine Water Co., under a 30 years' franchise. Engr., J. T. Jones. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Springs, pumping from receiving reservoir to stand-pipe and direct.

Nearly 100 springs in two valleys, ½ and 1 mile long, respectively, furnish the supply. The springs issue from the outcrop of a stratum of fine white sand which underlies from 8 to 10 ft. of clay, along the base of the hills. Each spring is enclosed with wooden curbs, lined with brick in cement, and covered with trap doors. Their flow is collected by 3 to 12-in. earthenware pipes.

Receiving Reservoir.—Is 65 ft. in diam. by 30 ft. deep, and has tight brick walls.

Pumping Machinery.—Dy. cap., 500,000 galls.; two pumps, designed by Wm. E. Worthen.

Stand-Pipe.—Plate iron, 2 ft. in diam., by 125 ft., high; 3,500 ft. from and on ground 90 ft. above pumps, and 35 ft. above town. Supported by eight wire rope guys, with turn buckles, four attached 80 ft. above the bottom and four at the top of the pipe.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i. *Taps*, 210. *Meters*, 11. *Hydrants*, kind not given, 10 public and 15 private.

Consumption, 240,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 65 lbs.

Financial.—Cost, about $130,000. Bonded debt, $80,000. Int., 6%. Ann. op. exp., $5,500. Ann. rev.: consumers $9,500; city, $1,075. Hydrant rental, $100 each.

Management.—Prest., M. L. Gray. Treas., Dwight Tredway. Supt., T. M. W. Glashan.

PARIS, *Lamar Co.* (Pop., 3,980; est., 12,000.) Ten miles south of Red river.

History.—Built in '88, and owned jointly by city and Paris Water Co. Engr., J. D. Thomas. Contrs., M. P. Kelley and E. E. Taylor, Georgetown, Texas.

Water Supply.—Well, pumping to stand-pipe.

Stand-Pipe and Distribution.—Not given.

Financial.—Cost, est., $102,000. The company furnished $20,000 in cash, which constitutes their capital stock, and the city issued $82,000 of bonds.

Management.—Prest. of Co., J. D. Thomas.

SAN ANGELO, *Tom Greene Co.* (Pop., 4,000; est., do.)

History.—Built in '84 by San Angelo Water-Works Co., under a 50 years' franchise. Des. Engr., Geo. F. Meyers. Labor done by company.

Water Supply.—North Concho river, pumping to tank and direct.

Pumping Machinery.—A 500,000-gall. compound duplex Deane pump, and horizontal tubular boiler.

Tank.—Cap., 60,000 galls.; wooden, 24 ft. in diam. by 18 ft. high.

Distribution.—*Mains*, w. i., 4 miles. *Services*, w. i., lead. *Taps*, 110. *Meters*, none. *Hydrants*, Chapman, Holyoke, 44. *Valves*, Chapman.

Consumption, 37,500 galls. *Pressure*; Ordinary, 50 lbs. *Fire*, 125 lbs.

Financial.—Cost, $40,000. Capital stock and bonds, $50,000. Int., not given. Ann. op. exp., $2,600. Ann. rev.: consumers, about $2,600. Hydrant rental, paid by property owners, and included under revenue.

Management.—Prest. and Mgr., J. L. Millpaugh.

SAN ANTONIO, *Bexar Co.* (Pop., 20,550; est., 45,000.) On San Antonio and San Pedro rivers. The business portion is nearly level, and on each side the ground rises gradually to an elevation of about 100 ft. Settled by Spaniards in 1714; incorp. a city in '73.

History.—Built in '78-9 by the San Antonio Water-Works Co., under a 50 years' franchise. Engr., W. R. Freeman, who, backed by the King Bridge Co., Cleveland, O. was also Contr.

Water Supply.—San Antonio springs, pumping to reservoir and direct. The springs are at the head of San Antonio river.

Dam.—Built by the Spaniards; of riprap, giving a head and fall of 9 ft., for driving the pumps.

Pumping Machinery.—Dy. cap., 6,000,000 galls.; four water-power and one steam Worthington pumps.

Reservoir.—Cap., 5,000,000 galls.; in excavation and embankment, with slopes paved with limestone. Is 18 ft. deep, and 150 ft. above city.

Distribution.—*Mains*, 24 to 4-in. c. i., 70 miles. *Services*, w. i., lead. *Taps*, 4,000. *Meters*, Crown, Worthington, 26. *Hydrants*, Mathews, Chapman, 410. *Valves*, Eddy, Chapman.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 90 lbs.*

Financial.—Cost, withheld, but est., $680,000. Capital stock, $680,000. Bonded debt, $680,000: $180,000 at 7, and $500,000 at 6%. Ann. op. exp., $20,000. Ann. rev.: consumers, withheld, but est., $120,000; city, $20,500. Hydrant rental, $50.

Management.—Prest., G. W. Brackenridge. V. Prest., F. Herff. Secy. and Supt., J. Ulrich. Treas., San Antonio National Bank.

SAN MARCOS, *Hays Co.* (Pop., 1,232; est., 2,500.) On San Marcos river. Settled in '20; incorp. a town in '76.

History.—Built in '83 by San Marcos Water Co., under a 12 years' franchise. Engr. and Contr., C. M. Holmes, Seguin.

Water Supply.—San Marcos river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 600,000 galls.; two Worthington water-power pumps of 8½-in. cylinder and 10½-in. stroke, and Gordon & Maxwell pump.

Reservoir.—Cap., 230,000 galls.; 60 ft. in diam. by 9 ft. deep, with walls of stone. Is 190 ft. above pumps and 150 ft. above town.

Distribution.—*Mains*, c. i., w. i., 6 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 13.

Consumption, 300,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 90 lbs.

Financial.—Cost, $30,000. Capital stock, $25,000. Bonded debt, $15,000. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $5,000; city, $1,125. Hydrant rental, $85 each.

Management.—Prest., C. M. Holmes, Seugin. Secy., Jas. T. Holmes. Treas., G. W. Donaldson. Supt., R. Pettit.

SEGUIN, *Guadalupe Co.* (Pop., 1,363; est., 2,500.)

History.—Built in '86-7 by Seguin Water & Ice Co., under 20 years' franchise. Engr., C. M. Holmes, Seguin. Labor done by company.

Water Supply.—Guadaloupe river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; water-power and steam pumps, make not given.

Stand-Pipe.—Cap., about 60,000 galls.; 10 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., w. i., 6 miles. *Services*, not given. *Taps*, 125. *Meters*, not given. *Hydrants*, Nelson, 15.

Consumption, 150,000 galls. *Pressure*: Ordinary, 43 lbs. Fire, 100 lbs.

Financial.—Cost, $26,000. Capital stock, $25,000. Bonded debt, $19,000. Int., 7%. Ann. op. exp., $1,270. Ann. rev.: consumers, $2,500; city, $1,050. Hydrant rental, $70 each.

Management.—Prest., W. D. Wood. Treas., J. M. Blanks. Secy. and Gen. Mgr., C. M. Holmes.

SHERMAN, *Grayson Co.* (Pop., 6,093; est., 10,000.) Thirteen miles from Red River.

History.—Built in '87-8 by city. Des. Engr., —— Hayne. Const. Engr., W. C. Connor, Dallas, Texas. Contr., E. Sutphin.

Water Supply.—Gang wells, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, cap. not given.

Stand-Pipe.—Cap., 300,000 galls.

Distribution.—Worthington meters and Chapman valves and hydrants are used.

Consumption, 100,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $70,000. Bonded debt, $70,000. Int., 8%.

Management.—Mayor, J. P. Gerin. Supt., Robert Harvey.

NOTE:—No further information given.

TAYLOR, *Williamson Co.* (Pop., est., 4,000.)

History.—Built in '82-3 by Taylor Water Co., under 50 years' franchise. Engr., J. T. Jones. Labor done by company.

Water Supply.—Springs and San Gabriel river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Blake pump at river and Worthington in city. Bought of Pond Engineering Co., St. Louis, Mo.

Tank.—Cap., 93,000 galls. Contrs., Kelley & Tomlinson, then of Taylor.

Distribution.—*Mains*, c. i., w. i., 7.4 miles. *Services*, w. i. Pipe and specials from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 140. *Meters*, none. *Hydrants*, Bailey, 21. *Valves*, Eddy.

Consumption, 140,000 galls. *Pressure*: Ordinary, 57 lbs. Fire, 90 to 125 lbs.

Financial.—Cost, withheld, but est., $65,000. Capital stock, $72,000. No debt or bonds. Ann. op. exp., $2,100. Ann. rev.: consumers, $6,000; city, $1,500. Hydrant rental, $100 each.

Management.—Prest., G. W. Burkitt. Secy., A. A. Stevens. Both of Palestine. Supt., T. P. Barton.

TEMPLE, *Bell Co.* (Pop., est., 5,000.)

History.—Built in '84 by Temple Water-Works Co., under 50 years' franchise. Engr., M. L. Lynch. Labor done by company.

Water Supply.—Surface wells, pumping to stand-pipe. A supply from the Leon river, 7 miles distant, has been talked of.

Pumping Machinery.—Dy. cap., 720,000 galls.; Worthington pumps, and two 40-H. P. steel boilers.

Stand-Pipe.—Cap., 55,000 galls.; of iron.

Distribution.—*Mains*, c. i., 2 miles. *Services*, c. i. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa. *Taps*, 87. *Meters*, none. *Hydrants*, kind not given, 13.

Consumption, 40,000 galls. *Pressure*: Ordinary, 52 lbs. Fire 100 lbs.

Financial.—Cost, $22,000. Capital stock, $15,000. Debt, not given. Ann. op. exp., $1,300. Ann. rev.: consumers, $1,600; city, $1,000. Hydrant rental, $83.33.

Management.—Prest. and Supt., G. E. Wilcox. Secy., O. K. Burwitz.

TERRELL, *Kaufman Co.* (Pop., 2,003; est., 4,000.) At head of small valley on divide between Trinity and Sabine rivers, in undulating country.

History.—Built in '84 by town. Des. Engr., G. C. Heron. Const. Engr., M. T. Brown. During construction the works were sold to M. T. Brown, but they are now owned by the city.

Water Supply.—Two wells, pumping to stand-pipe and direct. The wells are 25 ft. in diam. for 27 ft. in depth, and then have wells bored 45-ft. deeper.

Pumping Machinery.—Dy. cap., about 500,000 galls.; two Worthington pumps, and Atlas boilers.

Stand-Pipe.—Cap., about 45,000 galls.; 10 ft. in diam. by 75 ft. high, and on ground 75 ft. above pumps.

Distribution.—*Mains*, kalamein i., 3 miles. *Services*, not given. *Taps*, 160. *Meters*, none. *Hydrants*, kind not given, 32.

Consumption, about 200,000 galls. *Pressure*: not given.

Financial.—Cost, $27,000. Bonded debt, $35,000. Int., 7%. Ann. op. exp., $2,400. Ann. rev.: consumers, not given, but est., $4,000; city, none.

Management.—Supt., S. M. Cannon.

TEXARKANA, *Bowie Co.* (Pop., 3,225.)

General Description—A stand-pipe system *Hydrants*, 50. *Pressure*: 45 lbs. City Clerk, V. E. Burer. No further description can be obtained.

TEXAS STATE PENITENTIARY *Huntsville, Walker Co.* (Pop., 600.)

History.—Built in '84 by State.

Water Supply.—Artesian well, 630 ft. deep, pumping to stand-pipe and direct.

Pumping Machinery.—A 50,000-gall. Worthington pump.

Stand Pipe.—Cap., about 128,000 galls.; 16 ft. in diam. by 85 ft. deep.

Distribution.—*Mains*, 6 and 4-in. c. i., 2,500 ft. *Hydrants*, 16.

Consumption, 40,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $5,000. No debt or rev. Ann. op. exp., $800.

Management.—Foreman Machine Works, C. H. Robinson. Financial Agt., W. G. Parish.

TYLER, *Smith Co.* (Pop., 2,423; est., 7,000.) At headwater of Neches river, in rolling hilly country. Settled in '47; incorp. a village in '51, a city in '70.

History.—Built in '83 by Tyler Water Co., under 50 years' franchise. The works were begun by the city, but sold before their completion. Des. Engr., J. A. Jones. Labor done by local contractors.

Water Supply.—Springs, pumping from impounding reservoir to stand-pipe.

Dam.—Forms reservoir; of earth, with puddle core 3 ft. thick. It is unofficially reported that a heavy rain carried the dam away before it was finished, necessitating rebuilding.

Reservoir.—Not described.

Pumping Machinery.—Duplex high-pressure Worthington pump, dy. cap. not given.

Stand-Pipe.—Cap., 650,000 galls.; 35 ft. in diam. and 40 ft. high. Formerly there was a plate-iron tank 24 ft. in diam. by 22½ ft. high, on a brick tower 24 ft. sq. and 50 ft. high, with walls 3 ft. thick, and foundation walls 7 ft. thick. This tank was 100 ft. above the pumps and 119 ft. above the business part of the city.

Distribution.—*Mains*, 8 to 4-in. c. i., 10 miles. *Services*, w. i. *Taps* and *Meters*, withheld. *Hydrants*, kind not given, 60.

Consumption, 200,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 to 100 lbs.

Financial.—Cost, $115,000. Capital stock, $100,000. Bonded debt. $100,000. Int., 7%. Ann. op. exp., $3,000. Ann. rev.: consumers, $9,750; city, $2,175. Hydrant rental, $50 each.

Management.—Prest., L. B. Fish. Secy., B. W. Rowland. Treas., H. G. Asken. Supt., M. T. Brown. Report by Chas. V. Johnson, Town Clerk.

VICTORIA, *Victoria Co.* (Pop., 4,000; est., 5,000.) On Guadaloupe river.

History.—Built in '85 by city.

Water Supply.—Guadaloupe river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two 500,000-gall. Blake pumps, and two 35 H. P. boilers, all bought of Pond Engineering Co., St. Louis, Mo.

Stand-Pipe.—Cap., 150,000 galls.; 16 ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, Bailey, 47. *Valves*, Eddy.

Consumption, 45,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 150 lbs.

Financial.—Cost, about $45,000. Bonded debt, $45,000. Int., 6%. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,000.

Management.—Supt., Wm. Wheeler.

WACO, *McLennan Co.* (Pop., 7,295; est., 20,000.) On Brazos river, on ground rising to an elevation of 130 ft in 1½ miles. Settled in '30; incorp. a city in '58.

History.—Built in '78 and enlarged in '86-7 by Waco Water Co. Des. Engr., W. R. Freeman. Const. Engr., C. W. White.

Water Supply.—Wells and Brazos river, pumping to reservoir. Before the reservoir was built wooden tanks with a cap. of 100,000 galls were used.

Pumping Machinery.—Dy. cap. 3,500,000 galls.; a 1,000,000-gall. Worthington and a 2,500,000-gall Knowles pump, the latter erected in '88.

Reservoir.—Cap., 6,000,000 galls.; 140 ft. above city.

Distribution.—*Mains*, c. i., w. i., 24½ miles. *Services*, w. i. *Taps*, 1,100. *Meters*, 75. *Hydrants*, Mathews, 150. *Valves*, Eddy.

Consumption, 2,000,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $350,000. Capital stock, $100,000. Bonded debt, $300,000. Int., 7%. Ann. op. exp., $4,200. Ann. rev.: consumers, $22,000; city, $9,000. Hydrant rental, $80 each by old contract. In '88 the city and company were in disagreement. Several new contracts were proposed and it was unofficially reported that by a temporary agreement $75 each was to be paid for 117 hydrants.

Management.—Prest., C. W. White. Secy., H. D. White. Supt., A. J. Douglas.

WEATHERFORD, *Parker Co.* (Pop., 2,046: est., 5,000.) Eleven miles from Brazos river. Manufactures castor oil, flour and brooms.

History.—Built in '88 by Weatherford Water, Light and Ice Co., under 25 years' franchise. Engr., W. R. Freeman, Dallas, Tex.

Water Supply.—Large well with radiating tunnel, by pumping to elevated reservoir, thence by gravity.

Pumping Machinery.—Combined daily capacity, 1,000,000 galls. Two compound duplex pumps of 500,000 galls. each, and two Buckeye tubular boilers.

Reservoir.—Cap., 1,100,000 galls.

Distribution.—*Mains*, c. i., 3½ miles. From Chattanooga (Tenn.) Foundry & Pipe Co. *Services*, w. i. *Taps*, not given. *Meters*, none. *Hydrants*, Beaumont, 15. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $65,000. Capital stock, $50,000. Bonded debt, $50,000. Int., 7%. Hydrant rental, $75 each for first 15, $60 for additional.

Management.—Prest., W. J. Sherman. Secy. and Treas., R. W. Kindle. Supt., Jno. Bassett.

NOTE:—The company also operates in same building with pumping machinery and electric light and ice plant. Figures given, probably include cost of the entire plant.

Water-Works Projected with Fair Prospects of Construction.

BONHAM, *Tannin Co.* (Pop., 1,880; est., 5,000.)

Proposed System.—The city has voted $50,000 of bonds, and an artesian well is now being sunk. If successful, water-works will be established. City Secy., Jas. K. Blair.

BROWNSVILLE, *Cameron Co.* (Pop., 4938; est., 6,000.) On Rio Grande river.

Proposed System.—To take water from the Rio Grande river. Address M. B. Kingsbury.

CORPUS CHRISTI, *Nueces Co.* (Pop., 3,257; est., 5,000.) On Corpus Christi bay, near mouth of Nueces river.

Proposed System.—To pump water from artesian well to stand-pipe. The American Well Works Co., Aurora, Ill., were sinking a well in early part of '89, and city proposed to issue $33,000 of 8% bonds, and put in complete system as soon as water was obtained. Address Julius Henry, Chn. Water Com.

ENNIS, *Ellis Co.* (Pop., 1,351; est., 3,000.)
Proposed System.—To be built in '89. Address J. Boldridge or City Secy., F. A. Rust.

HENRIETTA, *Clay Co.* (Pop., est., 2,500 to 3,000.)
Proposed System.—In '88 the Henrietta Improvement Co. proposed pumping water from an artesian well to a reservoir. Address J. B. Hopkins to ascertain what has been done.

HILLSBORO, *Hill Co.* (Pop., est., 3,000.) On Brazos river.
Proposed System.—In '88 the city proposed granting 20 or 25 years' franchise. Address J. E. Ballard, Mayor.

ORANGE, *Orange Co.* (Pop., 3,800.) On Sabine river, at head of tide-water navigation.
Proposed System.—The city proposed building works in '88, contracts were made for material. Feb. 2, '89, works had not been built. Address Litcher & Moore.

WAXAHACHIE, *Ellis Co.* (Pop., 1,354; est., 3,500.)
Proposed System.—City to build works in '89. Address the Mayor, E. A. Du Bose.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Bowie, *Montague Co.*; Brady, *McCulloch Co.*; Bryan, *Brazos Co.*; Burnet, *Burnet Co.*; Coleman, *Coleman Co.*; Cross Roads, *Navarro Co.*; Cuero, *De Witt Co.*; Dublin, *Erath Co.*; East El Paso, *El Paso Co.*; Goldthwaite, *Mills Co.*; Hitchcock, *Galveston Co.*; La Grange, *Fayette Co.*; Manor, *Travis Co.*; Meridian, *Bosque Co.*; Trinity, *Trinity Co.*; Washburn, *Armstrong Co.*

COLORADO.

Water-Works Completed or in Process of Construction

ASPEN, *Pitkin Co.* (Pop., est., 6,000.) On Roaring Fork river, in mining region.
History.—Built in '86 by Castle Creek Water Co. Engr., M. W. Mathers, Glenwood Springs.
Water Supply.—Castle and Hunter creeks, by gravity.
Reservoir.—Cap., 20,000 galls.
Distribution.—*Mains*, kalamein i., 5 miles. *Services*, kalamein i. *Taps*, withheld. *Meters*, none. *Hydrants*, Ludlow, 37. *Valves*, Ludlow.
Consumption, unknown. *Pressure*: 95 lbs.
Financial.—Cost, $100,000. Bonded debt, $50,000. Int., not given. Ann. op. exp., $3,500. Ann. rev.: consumers, withheld, but est., $5,000; city, $3,350. Hydrant rental, $100 each for $30, and $50 for additional.
Management.—Prest., H. P. Cowenhover. Gen. Mgr., J. H. Devereux. Supt., H. G. Koch.

BERTHOUD, *Larimer Co.* (Pop., est., 300.)
History.—Built in '86 by Berthoud Ditch, Reservoir and Water Co. No franchise. Des. Engr., —— Salino.
Water Supply.—Surface water gathered in reservoir of 50 acres area, by gravity.
Distributing Reservoir.—Is 125 by 300 ft.
Distribution.—*Mains*, Wyckoff wood, 3 miles, from Michigan Pipe Co., Bay City. *Taps*, 50. *Hydrants*, Holly-Gaskill, 4. *Valves*, Galvin.
Pressure: 45 lbs.
Financial.—Cost, $12,000. Capital stock, $2,000. Debt, $5,500, of which $4,500 is in bonds. Int., 7%. Ann. op. exp., $100. Ann. rev.: consumers, $10,000; city, none.

BLACK HAWK, *Gilpin Co.* (Pop., 1,540.)
History—Built in '83-4 by town.
Water Supply.—Springs, by gravity.
Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, c. i., 10 (?) miles. *Services*, w. i. *Taps*, 250. *Meters*, 2. *Hydrants*, kind not given, 12.

Consumption, 200,000 galls. *Pressure*: 115 lbs.

Financial.—Cost, $14,000. Debt, $14,000. Int., 8%. Ann. op. exp., $1,975. Ann. rev.: consumers, $5,170; city, none.

Management.—City Marshal, Wm. R. Backus. Town Clerk, S. H. Bradley.

BOULDER, *Boulder Co.* (Pop., 3,069; est., 4,000.) On Boulder creek. Engaged in coal, gold and silver mining. Settled in '59; incorp. in '71.

History.—Built in '75 by town. Des. Engr., J. S. Titcomb.

Water Supply.—Boulder creek, by gravity to and from reservoir. The point of supply is about three miles from town. An open ditch, one mile long, leads to the reservoir.

Dam.—Forms reservoir: masonry, built between foot hills.

Reservoir.—Between hills, partly in elevation, 150 ft. above city.

Supply Pipe.—Of 10-in. c. i. for 1,000 ft., then reduced to 8 in. for 1,000, when it branches into smaller sizes.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i., lead. *Taps*, 450. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, unknown. *Pressure*: 65 lbs.

Financial.—Cost, $50,000. Debt, $38,000. Int., 8 and 10%. Ann. op. exp., $600. Ann. rev.: consumers, $5,600; city, none.

Management.—Supt., J. E. Bemus. Town Clerk, E. J. Borden.

BRECKENRIDGE, *Summit Co.* (Pop., 1,657.)

General Description.—Owned by town. Direct pumping system. *Mains*, 1½ miles. *Hydrants*, 22. *Pressure*: 90 lbs. Secy., Wm. Foreman.

No more details given.

BUENA VISTA, *Chaffee Co.* (Pop., est., 1,200.) On Arkansas river at an elevation of 7,500 ft. A mining and smelting town. Settled in '79.

History.—Built in '83 by town. Des. Engr., B. C. Libby. Contrs., Colo. Machinery Co., Denver.

Water Supply.—Cottonwoood creek, at a point two miles from and 150 ft. above town, by gravity.

Distribution.—*Mains*, 10 to 4-in. Kalamein i. *Services*, not given. *Taps*, 85. *Meters*, none. *Hydrants*, Ludlow, 12. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: 65 lbs.

Financial.—Cost, $30,000. No further information given, as no record has been kept since '85.

Management.—Secy., T. F. McGiffe.

CANON CITY, *Fremont Co.* (Pop., 1,501; est., 3,100.) On Arkansas river.

History.—Built in '80 by company, and sold to city.

Water Supply.—Ground water, by direct pumping.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: two Blake pumps of 12-in. bore and 24-in. stroke, driven by water-power.

Distribution.—*Mains*, c. i., 5 miles. *Services*, galv. i. *Taps*, 241. *Meters*, 1. *Hydrants*, kind not given, 24.

Consumption, 460,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, about $60,000. Bonded debt, $60,000. Int., 7%. Ann. op. exp., $2,000. Ann. rev.: consumers, not given, but est., $6,500; city, $1,575.

Management.—Supt., G. T. Conaway.

CASCADE, *El Paso Co.* (Pop., est., 100.)

History.—Built in '87 by Cascade Town & Improvement Co. Engr., Wm. Frizzell.

Water Supply.—Cascade creek, by gravity from elevated point in canyon. Dam and settling basin not described.

Distribution.—*Mains*, 8-in. iron, from H. Watson, Alton, Ill., 2 miles. *Services*, galv. i. *Taps*, not given. *Meters*, none. *Hydrants*, Chapman, 7. *Valves*, Chapman, 7.

Financial.—Cost, $6,000. No debt.

Management.—Prest., D. Severy. Secy., E. M. Hewlett.

CENTRAL CITY, *Gilpin Co.* (Pop., 2,626; est., 7,000.) Engaged in milling, gold mining and smelting.

History.—Built in '86-9 by town. Engr., Jas. Davidson.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 525,000 galls.

Distribution.—*Mains*, c. i., 2 miles. *Services*, not given. *Taps*, 75. *Meters*, 10. *Hydrants*, Ludlow, 29. *Valves*, Ludlow.

Consumption, 25,000 galls. *Pressure*: 100 lbs.

Financial.—Cost, $35,000. Bonded debt, $21,000. Int., 10%. Ann. op. exp. and rev., not determined.

Management.—Chn. Com., T. H. Potter. Supt., Jas. Davidson.

COLORADO CITY, *El Paso Co.* (Pop., 347; est., 3,000.) Engaged in mining, milling and smelting.

History.—Built in '88 by Colorado City Water Co., under a 20 years' franchise. Engr., Anthony Bott. Contrs., Russell & Alexander, Colorado Springs.

Water Supply.—Sutherland creek, by gravity to reservoir.

Reservoir.—Cap., 8,000,000 galls.

Distribution.—*Mains*, c. i., about 4 miles. *Taps*, 100. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, not given. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $30,000. Capital stock, $20,000. No debt.

Management.—Prest. and Treas., Anthony Bott. Secy., J. K. Vanatta.

COLORADO SPRINGS, *El Paso Co.* (Pop., 4,226; est., 8,000.) On Monument creek on a level plateau near Pike's Peak, at an elevation of 6,022 ft., which is city datum. A health resort.

History.—Built in '79 by town with W. B. Sherman as Des. Engr.

In '86-7 the works were extended with City Engr., H. I. Reid in charge. Water is furnished to Manitou.

Water Supply.—Ruxton's creek, by gravity to distributing reservoirs. The point of supply is 7 miles from the city, on the eastern slope of Pike's Peak. The stream is fed from springs and perpetual snow.

Dam.—Across creek. Not described.

Conduit.—Of 10-in. c. i., six miles long, and having a fall of 1,000 ft.

Reservoirs.—Combined cap., 17,000,000 galls. Each is in excavation and embankment, about one mile from and 200 ft. above the city, a small dam across the valley of a stream, helping to form the first, which has a cap. of 2,000,000 galls. The bottom of the larger reservoir is covered with 2 ft. of puddle, above which is 18 in. of clean gravel. All pipes leading through the banks of the new reservoir are thoroughly bedded in hydraulic cements, with collars of the same.

New Supply Main.—Of 16-in. pipe, with 12, 10 and 8-in. sub-mains. The main from the old reservoir has been retained, and the two can be connected or used independently.

Distribution.—*Mains*, c. i., 27 miles, including conduit and supply pipes. *Services*, w. i., lead. *Taps*, 1,500. *Meters*, 2. *Hydrants*, kind not given, 56.

Consumption, 1,500,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $200,000. Debt, $117,000. Int., 6%. Ann. op. exp., $3,000 Ann. rev., consumers, $20,000; city none.

Management.—Secy., H. C. McCreery. Supt., Edw. W. Frost.

DENVER, *Arapahoe Co.* (Pop., 35,629; est., 90,000.) At junction of South Platte river and Cherry creek, on a series of plateaux rising gently from the river. Settled in '59. Altitude, 5,300 ft.

History.—Built in '71-2 by Denver Water Co. Engr., Jas. Archer. In '80 and again in '86 the works were extended and the supply increased.

OLD WORKS—'72 TO '80.

General Description.—Water was pumped directly to the mains from the South Platte river. A cribbed well was built in the east bank of the river at the base of the city. It was 42 by 56 ft., with a branch extending towards the river, 20 by 60 ft. The depth was 22 ft. For the first 10 ft. the walls were timber with 4 ft. of broken stone in the center. The remaining 12 ft. was of stone. The well was roofed. After a few years a pipe was laid to the river for use in case of fire.

The pumps were Holly, there being six gang pumps and four rotary, with combined dy. cap. of 2,500,000 galls. These works were abandoned with the completion of the new plant, described below.

NEW PUMPING WORKS.—BUILT IN '80.

Water Supply.—Now from vertical and horizontal wells along the bank of South Platte river, by gravity through conduit to reservoir, thence by direct pumping. The first supply from this plant was from the river through a canal to an artificial lake, with a filter in a forebay, thence by direct pumping. A fall of 28 ft. in the canal affords water-power for pumping, which is still used.

Dam.—Of masonry for 160 ft. in length, then of brush, clay and piling.

Canal.—About 2¼ miles long, 7 ft. deep, 35 ft. wide at the bottom, and 50 at the top.

Archer Lake.—The canal widens into a basin covering, with the area of the canal, 40 acres, and having a depth of 88 to 20 ft.

Wells.—Along low banks of Platte river, horizontal, about 1,200 ft. long, built up of redwood staves, some rectangular and some semicircular in section. The staves are joined at the ends by sheet iron let into a saw-kerf and held together by coated ¾-in. rods, or hoops. Spaces of ¼ in. are left between the staves to admit water.

Conduit.—A 4-ft. conduit extends from the wells about 2½ miles to a small reservoir. The conduit crosses the river. Dy. cap., 16,000,000 galls.

Reservoir.—About 300 by 400 ft, paved with stone in cement.

Pumping Machinery.—The first four pumps were driven by water-power, and had a cap. of 1,500,000 galls. each. Two 54-in. American turbines, giving 250 H. P. each when worked under a head of 30 ft., were first used. In '85 one of these was replaced by double Leffel wheel of over 300 H. P.

In '81 two 3,000,000-gall. Holly steam pumps were added, and in '82 these were reinforced by 400 H. P. Holly engines, and four 4½ by 18-ft. boilers. All of the power from water and steam may be applied to the main shaft, which is continuous and drives the six horizontal pumps, or all the pumps may be run by water or by steam, or any pair of them. Steam power is used only during the irrigating season.

Electic Lighting.—A 16-in. water wheel driven by waste water from the turbine drives a 150-light 16 c. p. Edison dynamo, saving $20 a month over lighting by kerosene oil. In the day time this power is used for the machine shop.

GRAVITY WORKS.—BUILT IN '86.

Water Supply.—Horizontal and vertical wells in bed of Cherry creek, 8 miles from center of city, by gravity to distributing reservoir and stand-pipe. The horizontal wells were similar to those described above, and from 12 to 13 ft. below the surface. Vertical wells Nos. 1, 3 and 4 are each 10 ft. in diam., constructed of 2 by 6-in. rough lumber cased with oak to within a few feet of the surface, from which point hard burned brick are used and the top arched over with them. Well No. 2 is larger than the others. The wells are from 20 to 25 ft. deep, and within each one is a second, perforated well, tapering from 30-in. at the bottom to 12 at the top. These are also of timber, and extend to bed rock, about 35 ft.

Conduit.—Wooden, 37 in. in diam., about 7 miles long with a dy. cap. of 10,000,000 galls.

A general grade of 1-20 in 100 was established, but in several places this is not followed. There are several curves in the conduit. The deepest cut was from 9 to 21 ft., and in this 3-in. Colorado pine staves were used, and in others, 2-in. In depressions native lumber was used and on higher elevations California redwood, while in some places the lower portion was built of pine and the upper of redwood. The conduit was banded with ½-in. iron rods, spaced according to internal pressure, with three as a factor of safety.

Reservoir.—Cap., 7,000,000 galls.; in embankment, 120 by 559 ft., and 20 ft. deep. The bottom has a fall of 18-in. The outer slopes are 2 to 1; inner, 1½ to 1. The banks are 14 ft. wide on top, and are carried 3 ft. above water. It is not lined. A wooden roof, supported on wooden posts, covers the reservoir. The sheathing of the roof is not close, there being spaces from ½ to 1 in. between the boards. About one-fifth of the area of the roof consists of trap doors, which are opened in the fall to provide against heavy strains from snow. The roof has prevented the growth of algæ in the reservoir, which would otherwise have proved very troublesome.

Stand-Pipe.—To equalize pressure. Is of California redwood, joined to the redwood pipe by a large casting with two horizontal and one vertical bell ends. The pipe is braced by four tubes tied together with rods, extending from near the top of the pipe to the ground, where each tube rests on 8 tons of masonry. These tubes also serve as overflow pipes. They are in three sections of 6, 5 and 4-in. inside diam. from the bottom up.

The remaining facts apply to the whole system.

Distribution.—*Mains*, c. i., 60 miles. *Services*, lead. *Taps*, 5,000. *Meters*, 20. *Hydrants*, Holly, 350. *Valves*, Eddy.

Consumption, 5,500,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $1,200,000. Capital stock, $1,500,000. Bonded debt, $500,000. Int., 7, 8 and 10%. Ann. op. exp., withheld, but est., $60,000. Ann. rev.: consumers, withheld, but est., $160,000; city, $20,000 for hydrants and street sprinkling.

Management.—Prest., Wm. B. Mills. V. Prest., G. W. Clayton. Treas., G. W. Kasslen. Secy. and Supt., Richard Holmes. Pumping Engr., Chas. P. Allen.

NOTE:—Some of the novel features of this system, such as the horizontal wells the redwood conduit and stand-pipe, the reservoir roof and the growth of algæ in the reservoirs, are described and illustrated in detail in *Engineering News*, vol. XIX., pages 334-4, and vol. XX., pages 222-3, 240-2. The articles in vol. XX. are by S. Fortier.

DURANGO, *La Plata Co.* (Pop., 2,500; est., 3,000.) On Animas river, in mining region. Settled and incorp. a town in '80.

History—Built in '83-4 by town. Des Engr., C. M. Perin. Contrs., South Pueblo Machinery Co.

Water Supply.—Animas river, puming to reservoir.

Dam.—Across river. Is 6 ft. high, of logs, rock and earth.

Pumping Machinery.—Two Deane pumps, dy. cap., 500,000 galls. Originally two Leffel water wheels drove a 9-in. pump of 24-in. stroke, made by the Contrs.

Reservoir.—Cap., about 500,000 galls.; 100 ft. sq. and 6 ft. deep, with outer slopes of 2 to 1, and inner of 1 to 1, the latter puddled with clay. It is 350 ft. above the pumps,

Distribution.—*Mains*, 10 to 4-in. c.i., 3½ miles. *Services*, galv. i. *Taps*, 150. *Meters*, 1. *Hydrants*, kind not given, 25.

Consumption, 150,000 galls. *Pressure*: 165 lbs.

Financial.—Cost, $80,000. Bonded debt, $80,000. Int., 8% Ann. op. exp., $4,000. Ann. rev.: consumers, $3,500; city, none.

Management.—Supt., Chas. S. Butler.

FAIRPLAY, *Park* Co. (Pop., 450; est., 750.) At head of South Park, at an elevation of 9,674 ft. Engaged in gold and silver mining.

History.—Built in '82 by village, under direction of Geo. W. Nyce. Contr., Jas. W. Rich.

Water Supply.—Spring, by gravity to and from reservoir.

Ditch.—From spring to reservoir; is 3 ft. wide, 1½ ft. deep and ¾ miles long.

Reservoir.—In excavation, 50 by 150 ft. at bottom, 90 by 220 ft. at top, 78 ft. above, and 2,500 ft. from center of town.

Distribution.—*Mains*, lap-welded w. i., 3½ miles. *Services*, galv. i., block i. *Taps*, (in '86,) 75. *Meters*, (in '86,) none. *Hydrants*, kind not given, 35.

Consumption, unknown. *Pressure*: 40 lbs.

Financial.—Cost, $10,000. Debt $8,500. Int., 8%. Ann. op. exp., about $300. Ann. rev.: consumers, about $600.

Management.—Supt., Geo. W. Nyce. Town Clerk, P. S. Hickey.

FORT COLLINS, *Larimer Co.* (Pop., 1,356; est., 3,000.) On Cache la Poudre river on level ground. Settled in '65; incorp. a city in '73.

History.—Bult in '82-3 by city. Engr., H. P. Handy, Fort Collins. Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Cache la Poudre river, by gravity to settling reservoir, then by gravity to a second reservoir, thence by direct pumping. The point of supply is about five miles west of the city.

Filter.—At the river; a wooden crib filled with cobblestone and gravel. From this an open canal leads 400 ft. to the settling reservoir.

Settling Reservoir.—Cap., 3,000,000 galls.

Dam.—Forms reservoir; of earth with center of 3-in. spruce plank. An open canal 10 ft. wide and 6 ft. deep conveys water to a reservoir at the pump.

Second Reservoir.—Cap., 2,000,000 galls.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; four Holly-Gaskill pumps, driven by two 36-in. American turbines of 150 H. P., under 22 ft. head.

Force Main.—Of 12-in. lap-welded wrought iron, about 3½ miles long.

Distribution.—*Mains*, lap-welded w. i., 11 miles, including force main. *Services*, galv. i., lead. *Taps*, 336. *Consumers*, 408. *Meters*, none. *Hydrants*, Holly, 42. *Valves*, Holly.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $105,000. Debt, $105,000. Int., 7 and 8%. Ann. op. exp., $1,200. Ann. rev.: total, $5,596.

Management.—Supt., C. B. Rosenow.

GEORGETOWN, *Clear Creek Co.* (Pop., 3,294; est., 2,500.) Engaged in mining.

History.—Built in '74 and extended or rebuilt in '85 by Clear Creek Water Co., under 20 years' franchise.

Water Supply.—Clear Creek, by gravity.

Reservoir.—Not described.

Distribution.—*Mains*, c. i., 3 miles. *Services*, lead. *Taps*, withheld. *Meters*, none. *Hydrants*, Ludlow, 19. *Valves*, Ludlow.

Consumption, not given. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $35,000. No debt. Ann. op. exp., about $2.500. Ann. rev.; consumers, withheld, but est., $4,000; city, $1,450. Hydrant rental, $125, $75 and $50, according to number.

Management.—Prest. and Acting Secy., A. R. Forbes. Treas., C. R. Fish. Supt. H. P. Bullis.

GLEN PARK, *El Paso Co.* Supplied from Palmer Lake, which see.

GLENWOOD SPRINGS, *Garfield Co.* (Pop., est., 1,000.) At junction of Grand and Roaring Fork rivers. Has hot springs.

History.—Built in '88 by Glenwood Light & Water Co. Engr., Mason W. Mather.

Water Supply.—No Name creek, by gravity.

Conduit.—In three sections. The first is of wood, 7,000 ft. long; the second 6,000 ft. long and connects with the pump house; the third is an 8-in. branch extending across Grand river, conveying water direct to mains. The river section was laid as one piece from a staging built across the river. It is anchored by iron stakes driven on its lower side. A pressure regulator was placed at end of this section. The head at the river is 466 ft.

Distribution.—*Mains*, 24 to 4-in. kalamein i., 5½ miles; from National Tube Works Co., McKeesport, Pa. *Services*, *Taps* and *Meters*, not given. *Hydrants*, kind not given, 16.

Pressure: 200 to 48 lbs.

Financial.—Cost, $91,000.

Management.—Gen. Mgr., Mason W. Mather.

GOLDEN, *Jefferson Co.* (Pop., 2,730; est., 3,500.) On Clear creek, a fork of the South Platte river, at an elevation of 5,600ft. Engaged in mining, smelting, and in manufacturing flour, glassware, drain tile, pottery and brick. Settled in '59; incorp. a city in '72.

History.—Built in '79 by city. Principal Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Springs and Clear Creek, by direct pumping.

Reservoir.—Cap., about 350,000 galls.; 50 by 100 ft., by 12 ft. deep.

Pumping Machinery.—An 800,000-gall. Holly pump.

Distribution.—*Mains*, c. i., 5 miles. From Dennis Long & Co., Louisville, Ky. *Services*, lead. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 30. *Valves*, Holly.

Consumption, 600,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 150 lbs.

Financial.—Cost, $55,000. Bonded debt, $50,000. Int., 8%. Ann. op. exp., about $4,500. Ann. rev.: consumers, about $4,000; city, $2,000.

Management.—Supt., Geo. Kimball.

GRAND JUNCTION, *Mesa Co.* (Pop., est., 1,500.) On Grand river.

History.—Built in '88-9 by Grand Junction Water Co., under a 20 years' franchise. Engr., J. S. Simmons.

Water Supply.—Grand river, pumping to stand-pipe.

Stand-Pipe.—Cap., 58,800 galls.; 10 by 100 ft.

Pumping Machinery.—Cap., 1,500,000 galls.; Knowles pump.

Distribution.—*Mains*, iron and cement, 4 miles. *Services*, *Taps* and *Meters*, not given. *Hydrants*, kind not given, 50.

Financial.—Cost, est., $60,000. Capital stock, $60,000. Hydrant rental, $3,250 for 50 hydrants, or $65 each.

Management.—Prest., W. G. Reeve, Peru, Ill. Secy., W. J. Park, Larned, Kan. Supt., W. J. Krusen.

GUNNISON, *Gunnison Co.* (Pop., 888; est., 2,000.) On Gunnison river. Engaged in mining. Settled about '76.

History.—Built in '82 by Gunnison Gas & Water Co., under a 25 years' franchise. Engr., D. J. McCanne, the present Supt. Contr., Carroll E. Gray, Jr., Chicago, Ill.

Water Supply.—Gunnison river, pumping to tanks and direct. The river is a swift mountain stream draining about 1 sq. m.

Conduit.—Stone and brick, leading 2,000 ft. from river to pumps.

Pumping Machinery.—Dy. cap., 750,000 galls.; Worthington pumps one a compound duplex with 12-in. steam cylinders of 18-in. stroke, and 10-in. water cylinders of 10 in. stroke, and the other with 16-in. steam, and 10½-in. water cylinders, both of 10-in. stroke.

Tanks.—Cap., 60,000 galls.

Distribution.—*Mains*, c. i., kalamein i., 3½ miles. *Services*, galv. lead. *Taps*, 105. *Meters*, 1. *Hydrants*, kind not given. 52.

Consumption, 100,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 100 lbs.

Financial.—Cost, $85,929. Capital stock, $200,000. No debt. Ann. op. exp., $3,592. Ann. rev.: consumers, $3,043: city, $3,700. Hydrant rental, $100 each.

Management.—Prest., B. W. Lewis. V. Prest., J. N. Schoonmaker. Supt., D. J. McCanne.

HIGHLANDS, *Arapahoe Co.* (Pop., est., 7,000.)

History.—Built in '87 by the Beaver Brook Water Co., under a 20 years' franchise. Des. Engr., J. Bryan. Const. Engr. and Contr., A. L. Holmes.

Water Supply.—Artesian wells, pumping to tank.

Tank.—Cap. not given; at an elevation of 400 ft.

Pumping Machinery.—Cap., not given. From Fairbanks, Morse & Co., Chicago, Ill.

Distribution.—*Mains*, 6 to 2-in. Wyckoff wood, 9½ miles; from Michigan Pipe Co., Bay City, Mich. *Services*, *Taps* and *Meters*, not given. *Hydrants*, Gaskill, 51. *Valves*, Galvin.

Financial.—Cost, $145,000. Debt, not given. Hydrant rental, $40.

Management.—Prest., M. C. Jackson. Secy., W. Whittaker. Supt., Jas. Bryan.

IDAHO SPRINGS, *Clear Creek Co.* (Pop., 733; est., 2,000.) Has mineral springs.

History.—Built in '88 by city.

Water Supply.—Mountain stream, by gravity to reservoirs.

Reservoirs.—Combined cap., 1,450,000 galls.; one of 1,000,000 galls., and one of 450,000 galls.

Distribution.—*Mains*, 10-in. c. i., 2 miles. *Services*, wood. *Taps*, 130. *Meters*, none. *Hydrants*, kind got given, 21.

Pressure: Ordinary, 90 lbs. Fire, 120.

Financial.—Cost, $25,000. Debt, $20,000. Int., 8%. Ann. op. exp., $1,200. Ann. rev.: consumers, not given; city, $2,000.

Management.—Supt., H. O. Walker.

LA JUNTA, *Bent Co.* (Pop., est., 1,500.) On Arkansas river.

History.—Built in '82-3 by A. T. & S. F. R. R. Co., now owned by La Junta Water Co. Des. Engr., A. A. Robinson, Topeka. Const. Engr., W. H. Earl, Newton, Kan.

Water Supply.—Well, 20 ft. in diam., pumping to tank and direct.

Pumping Machinery.—Combined cap., 950,000 galls. Two Knowles pumps, one being a compound duplex with 10½-in. cylinders.

Tank.—Cap., 54,000 galls.; 24 by 16 ft., on 25-ft. posts.

Distribution.—*Mains*, c. i., 3.3 miles. *Service* w. i. *Taps*, 214. *Meters*, none. *Hydrants*, Holly, 6.

Consumption, 450,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100.

Financial.—Cost, $30,000. Debt, not given. Ann. op. exp., $3,300. Ann. rev.: consumers, about $3,530, of which $960 is from R. R. Co.; city, $430. Hydrant rental, $72.

Management.—Supt., J. H. Scott, Pueblo, Col. Treas., E. Wilder, Topeka.

LAMAR, *Bent Co.* (Pop., est., 1,500.)

History.—Built in '87; now owned by city, who bought them from Lamar Water Co. Engr. and Contr., F. P. Arbuckle, Denver.

Water Supply.—Nine 2½-in. driven wells, pumping to tank and direct.

Tank.—Cap., 100,000 galls.

Pumping Machinery.—Cap., 500,000 galls. One duplex Knowles pump.

Distribution.—*Mains*, Wyckoff wood, 4 miles. Pipe and specials from, and trenching and pipe laying done by Michigan Pipe Co., Bay City. *Services*, ¾-in. iron. *Taps*, 100. *Meters*, none. *Hydrants*, Holly-Gaskill, 20.

Consumption, 100,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 130 lbs.

Financial.—Cost, $22,000. Bonded debt, $22,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,000; city, $1,500.

Management.—Supt., J. W. Synder.

LAS ANIMAS, *Bent Co.* (Pop., 52; est., 2,000.)

History.—Built in '89 by city. Engr., Frank P. Arbuckle, Denver.

Water Supply.—Open well, near river, pumping to tank and direct.

Tank.—Cap., 90,000.

Pumping Machinery.—Cap., 1,100,000 galls. Two compound non-condensing pumps, make not given.

Distribution.—*Mains*, c. i., 2¾ miles. *Services*, w. i. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 30.

Pressure: Ordinary, 25 lbs. Fire, 100 lbs.

Financial.—Cost, $28,500. Bonded debt, $28,500. Int., 8%.

Management.—Not given. Report by F. P. Arbuckle.

LEADVILLE, *Lake Co.* (Pop., 14,820; est., 20,000.) At head of Arkansas river, 10,500 ft. above the sea. Produces large quantities of lead and silver. Settled in '78; incorp. a city in '79.

History.—Built in '79 by Leadville Water Co., under a 20 years' franchise. Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Mountain streams, by gravity and by pumping to reservoir. The largest stream has a drainage area of 16 sq. m.

Dam.—Across gulch, 1½ miles from city.

Reservoirs.—One with a cap. of 20,000,000 galls., and one 200,000 galls. The first is formed by the dam. The latter is for distribution, is 185 ft. below dam, and 164 ft. above city.

Conduit.—In '81, 2,200 ft. of 12-in., and 5,364 ft. of 6-in. pipe connected the reservoirs.

Pumping Machinery.—A 1,000,000-gall. Cameron pump and steel boilers. The pump forces water to the distributing reservoir to supplement the gravity supply.

Distribution.—*Mains*, c. i., kalamein i., 5 miles. *Services*, w. i., lead. *Taps*, 850. *Meters*, none. *Hydrants*, Holly, 125. *Valves*, Peet, Ludlow.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $500,000. Capital stock, $300,000. Bonded debt, $200,000. Int., 8%. Ann. op. exp., $15,000. Ann. rev.: consumers, $30,009; city, $11,025. Hydrant rental, $125 each for 10, and $85 each for additional.

Management.—Prest. and Treas., Wm. E. Hawks. Supt. and Secy., C. N. Priddy.

NOTE:—The matter given under reservoirs is subject to corrections, as the report for '88 does not agree in detail with an earlier one, in which the size of the larger reservoir is given as 200 by 300 ft., by 16 ft. deep; and in place of the smaller, a wooden tank is described, 40 by 20 by 16 ft. The reservoirs may have been enlarged.

LONGMONT, *Boulder Co.* (Pop., 733; est., 1,800.) On St. Vrain river on undulating ground. Settled in '70; incorp. a town in '73.

History.—Built in '82 by town. Des. Engr., Danl. Ransom.

Water Supply.—St. Vrain river, filtered, by gravity to and from reservoir. The point of supply is 9 miles from town.

Filter and Well.—A stone culvert 2 ft. wide by 1 ft. high, covered with 2 ft. of sand and gravel, extends under the bed of stream. A short 8-in. pipe connects the filter with a well on the river bank.

Conduit.—Consists of 8 miles of 6-in. wrought-iron pipe.

Reservoir.—Cap., 665,000 galls.; in excavation, with brick walls and floor, 112 ft. above town.

Distribution.—*Mains*, w.i., 14½ miles, including conduit. *Services*, galv. i. *Taps*, 309. *Meters*, none. *Hydrants*, Bailey, 36. *Valves*, Eddy.

Consumption, 180,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 135 lbs.

Financial.—Cost, $72.000. Debt, $70,000. Int., 8%. Ann. op. exp., $250. Ann. rev.: consumers, $6,100; city, $2,000.

Management.—Supt., Geo. W. Brown.

LOVELAND, *Larimer Co.* (Pop., est., 1,000.)

History.—Built in '87 by city. Engr., E. Leisher. Contrs., Michigan Pipe Co., Bay City.

Water Supply.—Little Canon of Big Thompson river, by gravity.

Distribution.—*Mains*, 6-in. Wyckoff wood, 11⅛ miles. *Services*, wood, 2 and 3-in. *Taps*, 140. *Meters*, none. *Hydrants*, Holly, 12.

Pressure: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $41,400. Bonded debt, $41,000. Int., 7%. Ann. op. exp., $240. Ann. rev.: consumers, $2,000.

Management.—City Council. Supt., A. L. Holmes. Town Recorder, and report by W. S. Phipany.

MANITOU SPRINGS, *El Paso Co.* (Pop., est., 422.) A summer resort.

NOTE:—Receives its supply from Colorado Springs Water-Works. No further data can be obtained.

MONTROSE, *Montrose Co.* (Pop., est., 1,500.)

History.—Built in '88 by town. Engr., E. B. Sawyer. Contrs., Holmes & Wicks, Colorado Springs.

Water Supply.—River, pumping direct.

Pumping Machinery.—Deane pump, cap., not given.

Distribution.—Not described.

Financial.—Cost, est., $22,000.

Management.—Not given. Town Recorder, Henry Tarbell.

MORRISON, *Jefferson Co.* (Pop., 186; est., 250.)

History.—Built in '85-6 by Morrison Water Co., under 20 years' franchise.

Water Supply.—Bear creek, by gravity.

Distribution.—*Mains*, w. i., 0.8 miles. *Services*, w. i. and lead. *Taps*, 20. *Meters*, none. *Hydrants*, none.

Pressure: 30 lbs.

Financial.—Cost, $3,500. Capital stock, $5,000. No debt. Ann. op. exp., $96. Ann. rev.: consumers, $325.

Management.—Prest., P. Christinsen. Secy. and Treas., W. S. Smith.

OURAY, *Ouray Co.* (Pop., 864; est., 2,000.) On Uncompagree river, in gold and silver mining section.

History.—Built in '81 by town.

Water Supply.—Canon creek, by gravity.

Reservoir.—Not described.

Distribution.—*Mains*, c. i., 2 miles. *Services*, not given. *Taps*, (in '84,) 350. *Meters*, none. *Hydrants*, kind not given, 10.

Consumption, not given. *Pressure*: Fire, 150 lbs.

Financial.—Cost, $20,000. Bonded debt, $20,000. Int., 8%. Ann. op. exp., not given, but est., $500. Ann. rev.: consumers, $2,800.

Management.—Marshal, J. L. Knous. Clerk, Geo. C. Pierce.

PALMER LAKE, *El Paso Co.* (Pop., est., 1,000.)

History.—Built in '87 by Palmer Lake Water Co., under a 20 years' franchise, Des. Engr., J. H. Drinkwater. Const. Engr. and Contr., A. L. Holmes. Supplies Glen Park.

Water Supply.—Monument creek, by gravity.

Reservoir.—On creek, size not given.

Distribution.—*Mains*, 3 and 4-in. Wyckoff wood, 1½ miles; from Michigan Pipe

Co., Bay City. *Services, Taps* and *Meters*, not given. *Hydrants*, kind not given. 4.

Financial.—Cost, $3,000. Hydrant rental, $50.

Management.—Prest., W. H. Thompson. Secy., J. H. Drinkwater. Supt., W. Hughes.

PUEBLO, *Pueblo Co.* (Pop., 3,217; est. pop. supplied, 11,000.) At junction of Arkansas and Fountain-qui-bouille rivers, at foot of Rocky Mts., on rolling prairie and elevated table lands. South Pueblo, on opposite side of river, has been consolidated with Pueblo, but retains a separate post-office. Settled in '58; incorp. a city in '70.

History—Built in '74-5 by city. Engr., Jas. A. Richardson. Contrs., National Building Assoc., St. Louis, Mo. South Pueblo has a separate system described farther on.

Water Supply.—Arkansas river, by gravity to settling reservoirs, thence by direct pumping.

Dam.—Across river, not described.

Conduit.—From dam to reservoir, about 2 miles long. No further description given.

Settling Reservoirs.—Cap., 20,000,000 galls.; three, each covering five acres. Des. Engr., Galen W. Pearsons, Kansas City, Mo. From the reservoirs 2,000 ft. of 14-in. cast-iron pipe conveys water to the pumps. Vitrified stoneware pipe was first used, but it proved unsatisfactory.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; a Holly and a Holly-Gaskill pump, each with a cap. of 1,500,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, w. i., lead. *Taps*, 550. *Meters*, Crown, 12. *Hydrants*, Holly, 114. *Valves*, Chapman.

Consumption, 950,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $210,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., $7,200. Ann. rev.: consumers, $18,000; city, $750.

Management.—Eight Trustees. Chn., Jas. O'Brien. Treas., Jos. Colaway. Secy., G. G. Withers.

RED CLIFF, *Eagle Co.* (Pop., not given.) Report not received in time for insertion. Address M. E. Graham.

SALIDA, *Chaffee Co.* (Pop., 2,500; est., 3,500.) In valley of Arkansas river, 8,000 ft. above the sea. Engaged in iron, copper and silver mining. Settled and incorp. a town in '80.

History.—Built in '82 by town. Engrs. and Contrs., Russell & Alexander, Chicago, Ill., with J. E. Ford in charge.

Water Supply.—South Arkansas river, a small mountain stream, by gravity from reservoir.

Dam and Reservoir.—A dam 100 ft. long, of stone and brush, forms the reservoir. A wooden flume conveys water 65 ft. to a wooden tank, 10 by 20 ft., by 8 ft. deep.

Supply Main.—Leads to the town, two miles from and 280 ft. below the reservoir. Size and material not given.

Distribution.—*Mains*, c. i., w. i., 3 miles, not including supply mains. *Services*, galv. i. *Taps*, 150. *Meters*, none. *Hydrants*, Holly, 20.

Consumption, not given. *Pressure*: 56 to 80 lbs.

Financial.—Cost, $24,000. Bonded debt, $24,000. Int., 8%. Ann. op. exp., $400. Ann. rev.: consumers, $1,600; city, none.

Management.—Not given. Report by Geo. M. Crosby.

SILVER CLIFF, *Custer Co.* (Pop., 5,040; est., 1,500.)

History.—Built in '80, and now owned by Silver Cliff Water Supply Co., the city turning the works over to the bond holders in '86. The works are leased and operated by Wm. C. Holland.

Water Supply.—Springs and surface water, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; Holly pumps.

Reservoir.—Not described.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 22. *Valves*, Holly.

Consumption, 150,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 70 lbs.

Financial.—Cost, $75,000. Debt and int., not given. Ann. op. exp., $4,000. Ann.

rev.: total, $4,000. The town pays the company $1,200 a year, collecting the amount from those using the water for domestic purposes. The company collects rents from other consumers.

Management.—Prest., Jos. Stanley. Secy., F. C. Young. Supt., H. W. Foss. Lessee, Wm. E. Holland.

SILVERTON, *San Juan Co.* (Pop., 264; est., 2,000.) Engaged in mining and reducing gold and silver ores.

History.—Built in '82-3, and now owned by Silverton Water Supply Co. The works were built by the Silverton Water-Works Co., and sold at auction to its bond holders, who organized as above. Franchise was for 20 years.

Water Supply.—Source not given, by gravity from reservoir.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, 2 miles. *Hydrants*, 10. *Pressure*: 60 lbs.

Financial.—Capital stock, $5,000. No bonds or debt.

Management.—Prest., B. L. Carr. Mgr., H. O. Mountain.

SOUTH PUEBLO, *Pueblo Co.* (Pop., 1,446; est., 9,000.) On Arkansas river opposite Pueblo, and now consolidated with it.

History.—Built in '81 by Colorado Coal & Iron Co.

Water Supply.—Arkansas river, pumping to reservoirs.

Pumping Machinery.—Worthington pumps, dy. cap., 2,000,000 galls.

Reservoir.—Covers 10 acres.

Distribution.—*Mains*, c. i., 7 miles. *Services*, w. i., lead. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 68. *Valves*, Chapman.

Consumption, 300,000. *Pressure*: 60 lbs.

Financial.—Cost, $100,000. Debt not given. Ann. op. exp., withheld, but est. $9,000; city, $3,060. Hydrant rental, $45.

Management.—Supt., G. A. Shields. Report by M. H. Hilburn, Ft. Worth, Tex.

TELLURIDE, *San Miguel Co.* (Pop., est., 1,100.) At head of San Miguel river. Works are owned by town. No more information given.

TRINIDAD, *Las Animas Co.* (Pop., 2,226; est., 7,000.) On Las Animas river, about 6,000 ft. above the sea. Settled in '75; incorp. a city in '79.

History.—Built in '79 by Trinidad Water-Works Co. Engr. and Contr., Delas A Chappell, Chicago, Ill.

Water Supply.—Filter gallery and well near river, pumping to reservoir.

Filter Gallery and Well.—The gallery is 2 by 3 ft., by 300 ft. long, with dry stone walls covered with flat stone. The well is 25 ft. in diam. by 16 ft. deep. Both are in coarse gravel.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; double acting Cope & Maxwell pumps.

Force Main.—Is 12 in. in diam., about a mile long, and rises 310 ft.

Reservoir.—Cap., 4,0 0,000 galls. The reservoir reported in '82 had a cap. of 2,000,000 galls., was 250 ft. above main street, with bottom covered with concrete overlying puddle, and sides paved with flat stones having cemented joints.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i., lead. *Taps*, 450. *Meters*, Crown, (in '86.) 125. *Hydrants*, Chapman, Ludlow, 50. *Valves*, Chapman, Ludlow.

Consumption, 500,000 galls. *Pressure*: 135 lbs.

Financial.—Cost, $110,000. Capital stock, $50,000. Bonded debt, $50,000. Int., 7%. Ann. op. exp., about, $4,000. Ann. rev.: consumers, $10,000; city, about $4,500. Hydrant rental, $100 each for 25, and $70 each for additional.

Management.—D.A. Chappell, Chicago, Ill. Secy. and Supt., W. B. Cunningham.

WALSENBURG, *Huerfano Co.* (Pop., 377; est., 3,000.)

History.—Built in '88 by Walsenburg Water Co., under an exclusive franchise Engr. and Contr., T. F. Martin.

Water Supply.—Lake Miriam, by gravity. The lake is ½ mile long, 25 ft. deep, 3½ miles from, and 265 ft. above town.

Distribution.—*Mains*, 8 in. asphalt coated w. i., 6½ miles; from National Tube Works Co., McKeesport, Pa. *Services*, ¾-in. galv. i. *Taps*, 125. *Meters*, none. *Hydrants*, Ludlow, 16. *Valves*, Ludlow.

Pressure: Ordinary, 80 lbs. Fire, 115 lbs.

Financial.—Cost, $65,000. Capital stock, $75,000. Bonded debt, $30,000. Int., 8%.

Ann. op. exp., $400. Ann. rev.: consumers, $2,500; city, $2,000. Hydrant rental, $60 each.

Management.—Prest., Fred Walsen. V. Prest., A. Levy. Secy. and Treas., T. F. Martin. Supt., F. O. Roof.

Water-Works Projected with Fair Prospects of Construction.

ALAMOSA, *Conejos Co.* (Pop., est., 500.)

Proposed System.—The Antonito Water, Coal & Gas Co. propose building works in '89. Capital stock, $3,500. Water will be taken from San Antonio river. Prest., C. M. Simpson. Engr., C. Y. Butler.

ANTONITO, *Conejos Co.* (Pop., est., 600.)

Proposed System.—In '88 the city proposed sinking an artesian well. It was also unofficially reported that the Taos Valley Co. would lay 10 miles of pipe to convey water from Conejos river for fire and domestic purposes. Address S. W. Krupp.

GILMAN, *Eagle Co.* (Pop., est., 600.)

Proposed System.—It was unofficially reported in '87 that the Gilman Water Co. had been organized to build works, with a capital stock of $40,000, by G. J. Came, A. McDonald and others. In '88 a company, with Geo. Carver, as Prest., proposed erecting works at an est. cost, of $5,000.

GREELY, *Weld Co.* (Pop., 1,297; est., 3,000.) On Cache La Poudre river, five miles from its junction with Platte river.

Proposed System.—Early in '88 it was proposed to take water from Cache La Poudre river. Est. cost, $125,000 to $200,000. Later, it was unofficially reported that the Greely Reservoir & Irrigation Co. had been incorporated by H. M. Devobe and others, to build works, with a capital of $100, 000, and that the city had voted favorably to construct a system at a cost of $65,000. City Clerk, F. P. Frost.

SOUTH DENVER, *Arapahoe Co.* (Pop., est., 1,500.)

Proposed System.—City will issue $160,000 of bonds for works, water to be pumped from Platt river to a stand-pipe. Est. cost., $155,000. Address James A. Fleming, Mayor, P. O. Box 2,019, Denver, Col.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Saguache, *Saguache Co.*; Sterling, *Logan Co.*

NEW MEXICO.

Water-Works Completed or in Process of Construction.

ALBUQUERQUE, *Bernadillo Co.* (Pop., 2,315; est., 8,000.) On Rio Grande river, in mining region.

History.—Built in '86 by Albuquerque Water Co., under a 20 years' franchise. No Engr. employed.

Water Supply.—Surface and driven wells, pumping to reservoir. The surface well is 20 ft. in diam. by 25 ft. deep, and there are 52 driven wells, each 3 in. in diam. and 40 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; Holly-Gaskill compound condensing pumps.

Reservoir.—Cap., 3,500,000 galls.

Distribution.—*Mains*, kalamein i., 7½ miles. *Services*, galv. i. *Taps*, 160. *Meters*, 1. *Hydrants*, Ludlow, 62. *Valves*, Ludlow.

Consumption, 160,000 galls. *Pressure*: 90 lbs.

Financial.—Cost, $118,000. Capital stock, $110.000. Bonded debt, $110,000. Int., 7%. Ann. op. exp., $5,000. Ann. rev.: consumers, $6,000; city, $5,030. Hydrant rental, $85 each for 50, and $65 for extensions, 10 hydrants to the mile.

Management.—Prest., A. A. Grant. Supt., C. J. Stetson.

LAS VEGAS, *San Miguel Co.* (Pop., 6,000; est., 10,000.) On Gallinas river Engaged in stock-raising and mining. Settled in '44; incorp. a city in '82.

History.—Built in '81-2 by Aqua Pura Co., under 50 years' franchise. Engrs. and Contrs., Russell & Alexander, Chicago, Ill.

Water Supply.—Gallinas river, filtered, by gravity.

Dam.—Impounds stream; of timber, stone and clay, 6 miles from and 350 ft. above city.

Filter.—Water first passes through a crib on the shore, 6 ft. wide, filled with stone and sand, thence to a well, from which 100 ft. of 12-in. pipe leads to a settling reservoir in six compartments, 25 by 100 ft. From here 10 and 8-in. cast-iron pipe conveys water to the city.

Distribution.—*Mains*, c. i., 14 miles. *Services*, w. i. *Taps*, 646. *Meters*, none. *Hydrants*, Holly, 34. *Valves*, Ludlow.

Consumption, unknown. *Pressure*: 120 lbs.

Financial.—Cost, $160,000. Capital stock, $145,000. Bonded debt, $120,000. Int., 6%. Ann. op. exp., $4,000. Ann. rev.: consumers, $15,000; city, $2,700. Hydrant rental, $66 each.

Management.—Prest., W. A. Vincent. Supt., F. H. Pierce.

RATON, *Colfax Co.* (Pop., 2,500; est., 1,800.) On a plain. Has coal mines and railway machine shops. Setted about '79.

History.—Built in '80-1 by A. T. & S. F. R. R. Co., and known locally as the Raton Water Co. Des. Engr., A. A. Robinson, Topeka, Kan. Const. Engr., S. M. Rowe, Albuquerque. Material furnished and labor done by company.

Water Supply.—Springs and well, by gravity from former and by pumping to reservoir from latter. The springs, 20 in all, are 3½ miles from and 1,200 ft. above the town, and water is conveyed from them to the town through 2-in. pipe, over very broken ground. The well is a mile from town, on the bank of Raton creek. The gravity and pumping systems are connected; the latter is not run continuously.

Pumping Machinery.—Dy. cap., 230,000 galls.; two duplex Knowles pumps, and two horizontal tubular boilers.

Force Main.—Of 8-in. cast-iron, 8,000 ft. long.

Reservoir.—Cap., 75,000 galls.; 40 ft. sq. at surface and 10 ft. deep. Is on high ground.

Distribution.—*Mains*, c. i., 9½ miles, including supply and force mains. *Services*, w. i. *Taps*, 150. *Meters*, 1. *Hydrants*, Holly, 10.

Consumption, 230,000 galls. *Pressure*: 60 lbs.

Financial—Cost, $54,000. No apparent debt. Ann. op. exp., about $2,900. Ann. rev.: total, about $2,800. Hydrant rental is paid by subscription, $100 each for four.

Management.—Div. Foreman of Water Service, R. A. Steen, La Junta, Colo. The station agent collects rates.

SANTA FE, *Santa Fe Co.* (Pop., 6,635; est., 7,000.) On Santa Fè river, 7,044 ft. above the sea. An old Spanish settlement.

History.—Built in '81-3 by Water and Improvement Co., without Contrs. Des. Engr., Thos. J. Wnitman, St. Louis, Mo. Const. Engr., Jos. E. Barbour.

Water Supply.—Santa Fè river, by gravity from impounding reservoir.

Dam.—Forms reservoir; of stone masonry, 45 ft. thick at base and 10 at top, length not given.

Reservoir.—Cap., 30,000,000 galls.; is 3½ miles from and 345 ft. above town. It is stated that a second reservoir was built in '83. Originally a 10-in. main led to the city.

Distribution.—*Mains*, c. i., about 10 miles. *Services*, galv. i. *Taps*, and *Meters* not given. *Hydrants*, kind not given, 25.

Consumption, unknown. *Pressure*: 175 lbs.

Financial.—Cost to '83, $175,000. Capital stock, $180,000. Bonded debt, $110,000. Int., 6%. Ann. op. exp., $6,000. Ann. rev.: consumers, withheld, but est., $10,000; city, $2,500. Hydrant rental, $100 each.

Management.—Prest. and Treas., Robt. E. Carr, St. Louis, Mo. Supt. and Secy., E. B. Seward.

SILVER CITY, *Grant Co.* (Pop., 1,800; est., 3,000. Has mining industries.

History.—Built in '87 by Silver City Water Co., under a 25 years' franchise. Des Engr., W. S. Waring. Const. Engr., F. M. Iler

Water Supply.—Well, 60 ft. deep, pumping to reservoir and direct.

Tunnel.—Is 4 by 6 ft., by 500 ft. long.

Reservoir.—Cap., 250,000 galls.

Pumping Machinery.—Cap., 1,000,000 galls. One compound condensing Knowles pump.

Distribution.—*Mains*, 12 in. kal. i., 6 miles. *Services*, ¾ to 1½ in. galv. i. *Taps*, 160. *Meters*, Crown, 10. *Hydrants*, Ludlow, 22. *Valves*, Ludlow.

Consumption, 50,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 100 lbs.

Financial.—Cost, $80,000. Bonded debt, $75,000. Int., 5%. Ann. op. exp., $2,731. Ann. rev.: consumers, $4,300; city, $3,250. Hydrant rental, $150 for first 20, $125 for additional.

Management.—Prest., G. H. Utter. V. Prest., J. K. Livingston. Secy., H. Foster. Engr. and Supt., L. C. Munger.

SOCORRO, *Socorro Co.* (Pop., 1,272; est., 4,100.) On Rio Grande river.

History.—Built in '87 by city. Engr. and Contr., Geo. F. Woolston, New York City.

Water Supply.—Large mountain springs, by gravity.

Distribution.—*Mains*, kal. i., 5½ miles. *Services*, iron. *Taps* and *Meters*, not given. *Hydrants*, Ludlow, 25. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 65 lbs.

Financial.—Cost, $30,000. Bonded debt, $30,000. Int., 6%. Ann. op. exp., $1,500. Revenues: not given.

Management.—Water Com. appointed by council. Report by Geo. F. Woolston.

SPRINGER, *Colfax Co.* (Pop., 34; est., 750.)

History.—Built in '88-9 by Agua Crystalina Co.

Water Supply.—Large well, pumping to reservoir.

Financial.—Cost, est., $10,000.

Management.—Prest., Melvin W. Mills. V. Prest., P. P. Talle. Treas., E. Clouthier. Secy. Henry Sturges.

NOTE:—No further information could be given at time of report.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Lake Valley, *Sierra Co.* Lordsburg, *Grant Co.*

GROUP 8.—PACIFIC STATES.—Water-Works Completed, in Process of Construction or Projected in Washington, Oregon, California, Arizona, Nevada, Utah and Idaho.

WASHINGTON.

Water-Works Completed or in Process of Construction.

CHEHALIS, *Lewis Co.* (Pop., est., 1,200.) On Chehalis river.

History.—Built in '88-9 by Chehalis Water Co., under 40 years' franchise. To be in operation July 4, '89. Engr., H. A. Ray, Chehalis.

Water Supply.—Source not given, pumping to reservoir and direct.

Pumping Machinery.—Duplex pump, make not given, dy. cap., 500,000 galls.

Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, 8 and 6-in. wood and iron, 5 miles. *Services*, iron. *Pressure*: Ordinary, 43 lbs. Fire, 86 lbs.

Financial.—Cost, $20,000. Capital stock, $20,000.

Management.—Officers: Jno. Dobson, H. A. Ray, J. W. Parr and W. T. Forrest.

ELLENSBURGH, *Kittitass Co.* (Pop., est., 2,000.) On upper Takima river.

History.—Built in '88 by Ellensburgh Water Co. Engr., W. P. Mason.

Water Supply.—Wilson creek, by gravity to reservoir. The creek rises in the snow levels of the Cascade Mts.

Reservoir.—Not described.

Distribution.—*Mains*, of wood, from Puget Sound Pipe Co., Olympia.
Management.—Prest., B. E. Craig. Report by S. W. Barnes.
NOTE:—Other details not determined.

OLYMPIA, *Thurston Co.* (Pop., 1,232; est., 3,000,) On Puget Sound in timber country. Engaged in manufacturing and trade. Settled in '48; incorp. a town in '61.

History.—Built in '66 by Olympia Water Co., under 50 years' franchise. Engr., W. N. Horton.

Water Supply.—Morley creek and Ferguson springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 606,000 galls.; a Dow and a Hooker pump.

Reservoir.—Cap., 500,000 galls. In '84 a 3,0000,000-gall. reservoir was reported with an elevation of 190 ft. above pumps.

Distribution.—*Mains*, Horton wood, 14 miles; prior to '78 the mains were ordinary bored logs. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, not given. *Consumption*, 200,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $30,000. Capital stock, $20,000. Bonded debt, $10,000. Int., 10%. Ann. op. exp., $2,400. Ann. rev.: consumers, $5,000; city, not given.

Management.—Supt. and Gen. Mgr., E. S. Horton.

PALOUSE, *Whitman Co.* (Pop., est., 800.)

History.—Built in '88 by village, under direction of Trustees. Contr., Jno. Corkish, Seattle.

Water Supply.—Palouse river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 576,000 galls.; make not given.

Tank.—Cap., 122,000 galls.; Sub-contrs., Zerngible & Sherman, Palouse City. The force main to tank is of wood.

Distribution.—*Mains*, kalamein i., 3,000 ft. *Taps*, 20. *Meters*, none. *Hydrants*, 6. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $8,600. Debt, $7,400. Int., 7½%. Ann. op. exp., est., $600.

Management.—Temporary Supt., Robt. Powell. Report by F. M. Martin.

SEATTLE, *King Co.* (Pop., 3,533; est., 15,000.) On Elliot bay, Puget Sound. Engaged in lumbering, ship-building, manufacturing and coal mining.

History.—Built in '84 by Spring Hill Water Co. Des. Engr., H. H. McWilliams. Const. Engr., Jas. A. McWilliams, the present Supt.

Water Supply.—Lake Washington, three miles from city, pumping to reservoir and tank.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a compound direct-acting, and a simple compound Dow pump lift water to reservoir, and a compound high-pressure Dow pump lifts it from reservoir to tank. Two 4½ by 16-ft. boilers.

Reservoir.—Cap., 4,000,000 galls.: at elevation of 315 ft.

Tank.—Cap., 120,000 galls.; at elevation of 360 ft.

Distribution.—*Mains*, w. i., 12 miles. *Services*, w. i. Specials from Almond & Phillips, Seattle. *Taps*, withheld. *Meters*, 30. *Hydrants*, kind not given, 43. *Consumption*, 800,000 galls. *Pressure*: 25 to 120 lbs

Financial.—Cost, $250,000. Capital stock, $200,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp., withheld, but est., $6,000. Ann. rev.: consumers, withheld, but est., $15,000; city, $3,612. Hydrant rental, $84 each.

Management.—Prest., Bailey Galyert. Supt. Jas. A. McWilliams.

SPOKANE FALLS, *Spokane Co.* (Pop., 350; est., 8,000.) On Spokane river, which at this point falls about 180 ft. in 2,500.

History.—Built in '84 by city, and rebuilt in '88-9. Engr., R. A. Jones, who has had charge of the works since their inception. Contr. for original and new works, Philip Buehner, Portland, Ore.

Water Supply.—Spokane river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Holly water-power pumps.

Distribution.—*Mains*, kalamein i., 6 miles. *Services*, galv. i. *Taps*, 450. *Meters*, 6. *Hydrants*, kind not given, 44. *Consumption*, 500,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 113 lbs.

Financial.—Cost, $60,000. Debt, $50,000. Int., 8%. Ann. op. exp., $2,500. Ann. rev.: consumers, $13,000; city, none.

Management.—Supt., R. A. Jones.
NOTE:—The above does not include the new works.

TACOMA, *Pierce Co.* (Pop., 1,098; est., 10,000.) On Puget sound. Engaged in manufacturing and trade.

History.—Built in '85 by Tacoma Light and Water Co. Engr., Isaac W. Smith, Portland, Ore.

Water Supply.—Spanaway lake and Clover creek, 10 miles from city, by gravity to and from reservoir for low,andsprings by pumping for high service.

Conduit.—To reservoir; about 10 miles long; no further information given.

Reservoir.—Cap., 1,750,000 galls.; in southwestern part of city about 260 ft. above low tide. A 12-in pipe leads from the reservoir to the low service.

Pumping Machinery.—Dy. cap., 1,000,000-galls.; Holly pump driven by Leffel turbine. The pump is in a canyon 185 below, and 1,900 from the reservoir. The turbine is driven by water brought from springs in wrought iron pipe, under 85 ft. head. The pump forces water to elevations 380 ft. above the sound.

Distribution.—*Mains*, c. i., 13 miles. *Services*, galv. i. *Taps*, 600. *Meters*, 20. *Hydrants*, Mathews, 46.

Consumption, not given. *Pressure*: 78 lbs.

Financial.—Cost, $250,000. Debt and Int., not given. Ann. op. exp., not given, but est., $5,000. Ann. rev.: consumers, $7,500; city, $3,500. Hydrant rental, $78 each. All figures were not given because of the connection between the electric light and water plant.

Management.—Prest., Theo. Hosmer. V. Prest., W. D. Tyler. Secy. and Treas., J. H. Houghton.

VANCOUVER, *Clarke Co.* (Pop., 1,722; est., 3,000, and 1,000 additional at Vancouver Barracks.) On Columbia river. Settled in '50; incorp. a city in '68.

History.—Built in '68 by private company, name not given, under 25 years' exclusive franchise. Des. Engrs., Augusta Shaben and Lewis Meyers. Water is furnished to the Vancouver Barracks.

Water Supply.—Springs, about four miles distant, by gravity from impounding to distributing reservoirs.

Dam.—Across ravine to form reservoir; timber, 7 ft. high and 100 ft. long.

Impounding Reservoir.—Cap., 500,000 galls.

Conduit.—Of wood, 5½ in. in diam. and 3¾ miles long.

Distributing Reservoirs.—Cap., 30,000 and 500,000 galls. respectively; of brick, near and 90 ft. above city.

Distribution.—*Mains*, c. i., wood, 13 miles, including conduit. *Services*, galv. i. *Taps*, 350. *Meters*, 1. *Hydrants* 10 at Barracks, kind not given.

Consumption, 150,000 galls. *Pressure*: Fire, 75 lbs.

Financial.—Cost, $75,000. No debt. Ann. op. exp., withheld, but est., $3,000. Ann. rev.: consumers, withheld, but est., $10,000; city, none.

Management.—Prest., S. W. Brown. Secy., G. H. Steward, Supt., J. R. Wintler.

WALLA WALLA, *Walla Walla Co.* (Pop., 3,558; est., 5,000.) On Mill creek, nearly surrounded by the Blue Mts. Settled in '57; incorp. in '62.

History.—Built in '65 by Walla Walla Water Co.

Water Supply.—Springs, by gravity from collecting reservoirs.

Reservoirs.—Cap., about 1,500,000 galls., and 400,000 galls., respectively; the first is 1 0 by 250 and the second 75 by 130 ft., each 7 ft. deep.

Distribution.—*Mains*, kalamein i., 14 miles. *Services*, w i. *Taps*, 500. *Meters*, none. *Hydrants*, made at Walla Walla, 25. *Valves*, Eddy.

Consumption, 600,000 galls. *Pressure*: 38½ lbs.

Financial.—Cost, $125,000. Capital stock, $100,000. Bonded debt, $50,00. Int., 8%. Ann. op. exp., withheld, but est., $3,000. Ann. rev.: consumers, withheld, but est., $15,000; city, not given.

Management.—Prest., R. R. Rees. Supt., Jerome F. Bowman.

Water-Works Projected with Fair Prospects of Construction.

ASOTIN, *Asotin Co.* (Pop., est., 300.) On Snake river.

Proposed System.—Asotin Water-Works Co. to take water from Asotin creek through ditch 1½ mile long, by gravity. The ditch was dry in '88. Capital stock, $10,400. Prest., E. Bannister. Secy., H. E. Benedict.

NORTH YAKIMA, *Yakima Co.* (Pop., est., 2,000.)

Proposed System.—A 25 years' franchise has been granted to Geo. F. Woolston, New York City, who expects to build works in '89, pumping water from Natchez river, two miles distant, to a stand-pipe. Est. cost., $75,000. City Clerk, Geo. W. Rodman.

SPRAGUE, *Lincoln Co.* (Pop., 94; est., 2,000.) A railway town.
Proposed System.—City to build works in '89, pumping from well to reservoir, 25 by 70 ft. by 8 ft. deep. City Clerk, W. B. Lottman.

WALLULA, *Walla Walla Co.* (Pop., 142; est., 1,000.) On Mill creek.
Proposed System.—Wallula Water & Motive Power Co. to begin construction of works Apr., '89, taking water from Walla Walla river. Est. cost, $10,000. Address G. Cummings. Report by G. D. Goodwin.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Pasco, *Franklin Co.*

OREGON.

Water-Works Completed or in Process of Construction.

ALBANY, *Linn Co.* (Pop., 1,867; est., 2,500.) At junction of Willamette and Callapoocie rivers. Has manufactories.
History.—Built in '80 by J. A. Crawford.
Water Supply.—Santiam canal and Calapoocie river, by direct pumping.
Pumping Machinery.—Dy. cap., 500,000 galls.; two 250,000-gall. water-power pumps, make not known.
Distribution.—*Mains*, c. i., 3.6 miles. *Services*, galv. i., black i. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 5.
Consumption, 400,000 galls. *Pressure*: 40 to 50 lbs.
Financial.—Cost, $15,000. Debt and int., not given. Ann. op. exp., "no expense account kept." Ann. rev.: consumers, $1,800; city, $300. Hydrant rental, $100 each for three.
Management.—Owner and Supt., J. A. Crawford. Report by L. E. Gray.

ARLINGTON, *Gilliam Co.* (Pop., est., 700.)
History.—Built in '88 by Arlington Water Co.
Water Supply.—Columbia river, pumping to reservoir.
Pumping Machinery.—Dy. cap., 432,000 galls.; Blake duplex pump.
Reservoir.—Cap., 100,000 galls.
Distribution.—*Mains*, 6 and 8-in. wood, 2 miles; from Puget Sound Pipe Co., Olympia. *Services*, galv. i. *Taps*, 70. *Meters*, not given. *Hydrants*, kind not given, 8.
Consumption, 45,000 galls. *Pressure*: 83 lbs.
Financial.—Cost, $7,000. Capital stock, $5,000. Debt, $2,000. Int., 10%. Ann. op. exp., $1,200. Ann. rev.: consumers, $1,800; city, $960. Hydrant rental, $120 each.
Management.—Prest., J. E. Frick. Secy., A. C. Fry. Supt. and Engr., E. D. Parrot. Report by Jas. Smith.

ASHLAND, *Jackson Co.* (Pop., 842; est., 1,500.) Manufactures woolen goods, flour and lumber.
History.—Built in '87 by city. Address Milton Berry. No further information given.

ASTORIA, *Clatsop Co.* (Pop., 2,803; est., 6,000.) At mouth of Columbia river on low ground, the buildings in business portion being on piles. Has manufactories. Settled in '10; incorp. a village in '52, a city in '75.
History.—The present works were built in '83-4 by Columbia Water Co. Des. Engr., D. P. Thompson. Small works were built in '70 and '72, but no information is given regarding them.
Water Supply.—Mountain spring, by gravity. A previous report gives the supply as Bear creek, a small stream 12 miles east of the city, water being impounded in a 75,000 and a 100,000-gall. reservoir, about 300 ft. above the city.
Reservoir.—Cap., 100,000 galls. See above.
Distribution.—*Mains*, w. i., 13 miles. *Services*, galv. i. *Taps*, not given. *Meters*, 6. *Hydrants*, 1.
Consumption, 300,000 galls. *Pressure*: 45 to 65 lbs.

Financial.—Cost, $80,000. Capital stock, $100,000. No debt. Ann. op. exp., withheld, but est., $2,500. Ann. rev.: consumers, withheld, but est., $10,000; city, not given.

Management.—Prest., F. DeKum. Supt., Jas. W. Welch.

BAKER CITY, *Baker Co.* (Pop., est., 3,500.) On south fork of Powder river.

History.—Built in '88-9 by city. Contr., J. C. White, Baker City.

Water Supply.—Well, pumping to reservoir and direct.

Pumping Machinery.—Worthington compound duplex pump, dy. cap. not given.

Reservoir.—Cap., 500,000 galls.: in excavation, 150 ft. above city.

Distribution.—*Mains*, 10 to 6-in., 2 miles. *Hydrants*, 14.

Financial.—Cost, $20,000. Bonded debt, $20,000.

Management.—City Auditor, J. T. Donnelly.

COQUILLE, *Coos Co.* (Pop., 176; est., 600.) On Coquille river.

History.—Built in '85-6 by Occident Water Co.

Water Supply.—Springs, [probably] by gravity.

Distribution.—*Mains*, 4-in., 1 mile. *Hydrants*, 4.

Financial—Capital stock, $1,600.

Management.—Not given. Report by S. L. Leneve.

CORVALLIS, *Benton Co.* (Pop., 1,128; est., 2,000.) On Willamette river.

History.—Built in '87 by Corvallis Water Co.

Water Supply.—Willamette river, pumping to tank and direct.

Pumping Machinery.—Worthington pump, dy. cap. not given.

Tank.—Cap., 15,000 galls.

Distribution.—*Mains*, w. i., 4 miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, kind not given, 4.

Consumption, 50,000 galls. *Pressure*: Ordinary, 23 lbs. Fire, 90 lbs.

Financial.—Cost, $12,000. Capital stock, $20,000. Debt, $1,800. Int., 10%. Ann. op. exp., withheld, but est., $2,000. Ann. rev.: consumers, withheld, but est., $5,500; city, not given.

Management.—Supt., Wm. Graves.

EAST PORTLAND, *Multnomah Co.* (Pop., 2,934; est., 10,000.) On Willamette river, opposite Portland.

History.—Built in '81-2 by East Portland Water Co. Engr., W. S. Chapman, Portland. Contrs., H. D. McGuire & W. S. Chapman, Portland. Sub-contr. for masonry, buildings and tank, J. L. Spore, East Portland.

Water Supply.—Stephens springs, pumping to tank and direct.

Pumping Machinery.—Worthington duplex pump, dy. cap., 1,440,000 galls.

Tank.—Cap., 150,000 galls.; 60 by 80 ft., at an elevation of 80 ft.

Distribution.—*Mains*, 6 and 4-in. c. i., 10 miles. *Services*, w. i. Pipe and specials from Jno. Barrett, Portland. *Taps*, 500. *Meters*, 6. *Hydrants*, from Willamette Iron Works, Portland, 30.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 120 lbs.

Financial.—Cost, $60,000. Capital stock, $60,000. No debt. Ann. op. exp., $5,000. Ann. rev.: consumers, $12,600; city, $2,400. Hydrant rental, no permanent contract, but $200 a month was paid in '88, or $80 a year, each.

Management—Prest., Joe Burkhard. Secy. and Treas., W. W. McGuire. Supt., H. P. McGuire.

HOOD RIVER, *Wasco Co.* (Pop., 364; est., 200.) At junction of Columbia and Hood rivers. Settled in '82.

History.—Built in '83 by E. F. & H. C. Coe, under name of Hood River Hydrant Co.

Water Supply.—Spring, 150 ft. above village, by gravity.

Distribution.—*Mains* and *Services*, 1 to ½ in. w. i., 1 mile. *Taps*, 30. *Meters* and *Hydrants*, none.

Consumption, unknown. *Pressure*: 150 ft. head.

Financial.—Cost, $2,000. No debt or op. exp. Ann. rev.: consumers, withheld, but est., $600; city, none.

Management.—Owners, E. F. & H. C. Coe, the latter being Supt.

EUGENE CITY, *Lane Co.* (Pop., est., 3,000.) On Willamette river.

History.—Built in '86 by company, under exclusive franchise. Des. Engr., —— Chase, Corvallis. Const. Engr., Jno. Barrett, Portland.

Water Supply.—Willamette river, pumping to reservoir and direct.

Pumping Machinery.—Dy. cap., not given; two No. 9 Dow pumps.

Reservoir.—Cap., 250,000 galls.

Distribution.—*Mains*, 8 to 3-in. c. i. and w. i., 10 miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, 150,000 galls. *Pressure*: Ordinary, 73 lbs. Fire, 260 lbs.

Financial.—Cost, not given, but est., $40,000. Capital stock, $40,000. No bonds. Debt, $500. Int., 8%. Ann. op. exp., $1,000. Ann. rev.: consumers, not given, but est., $10,000; city, $1,000 for all hydrants.

Management.—Prest., T. W. Shelton. Secy., J. F. Robinson. Supt., G. R. Chrisman.

MEDFORD, *Jackson Co.* (Pop., est., 1,800.)

General Description.—Begun in fall of '88, and to be finished in summer of '89, by town. Water supply, Bear creek, by gravity and pumping. Cost, est., $5,000. Const. Engr., J. S. Howard.

MILTON, *Umatilla Co.* (Pop., est., 600.)

History.—Built in '88 by town. Const. Engr., Jno. Corkish, Portland. Contr., Jno. O'Brien.

Water Supply.—Walla Walla river, by gravity.

Distribution.—*Mains*, 12 to 6-in. wood, 1 mile; from Puget Sound Pipe Co., Olympia, Wash. T. *Services*, galv. i., black i. *Taps*, about 25. *Meters*, none. *Hydrants*, Holly, 4.

Consumption, not determined. *Pressure*: Ordinary, 24 lbs.

Financial.—Cost, $5,000. Bonded debt, $5,000. Int., 8%. Ann. op. exp., "light." Ann. rev.: consumers, about $400.

Management.—Supt., A. Allen.

OREGON CITY, *Clackamas Co.* (Pop., 1,263; est., 2,500.) On Willamette river. Has water-power and manufactories.

History.—Built in '86 by town.

Water Supply.—Willamette river, pumping to stand-pipe and direct.

Pumping Machinery.—Dy. cap., 250,000 galls.; four plunger, and a pisten pump, [probably] driven by water-power

Stand-Pipe.—Not described.

Distribution.—*Mains*, c. i., 2 miles. *Services*, w. i. *Taps*, 150. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, not given. *Pressure*: Ordinary, 75 lbs. Fire, 125 lbs.

Financial.—Cost, not given, but est., $10,000. Debt not given. Ann. op. exp., about $500. Ann. rev.: about $3,500.

Management.—Supt., W. H. Howell.

PENDLETON, *Umatilla Co.* (Pop., 949; est., 3,250.) On Umatilla river. Has manufactories.

History.—Built in '87 by town. Des. Engr., P. F. Morey. Const. Engr., W. A Sales. Contrs., Saunders & Church, Pendleton.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; compound duplex Blake pump.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, kalamein i., 5½ miles. *Services*, w. i. *Taps*, 300. *Meters* none. *Hydrants*, kind not given, 21.

Consumption, 300,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $35,000. Debt, $30,000. Int., 7%. Ann. op. exp., est., $5,000. Ann. rev.: consumers, est., $6,000.

Management.—Supt., J. H. Robbins.

PORTLAND, *Multnomah Co.* (Pop., 17,577; est., 40,000.) On Willamette river on a plateau rising gradually from the river bank. Settled in '44; incorp. in '51.

History.—Built in '58, and now owned by the city. H. Bloomfield, of San Francisco, Cal., was Engr. for the improvements made from '68 to '85. Until Jan. 1, '87, the works were owned by the Portland Water Co., when they were sold to the city for $450,000.

Water Supply.—Willamette river, pumping to reservoir. The early supply was by gravity from Balsh and Caruthers creeks, and by pumping from a well. In 69 the river was drawn upon, but the creeks furnished a large part of the supply as late as '76.

Pumping Machinery.—Dy. cap., 14,000,000 galls. for low, and 2,500,000 galls. for high service. All Worthington pumps, there being for low service two 5,000,000, a 3,000,000 and a 1,000,000-gall. pumps.

The first pump used, that at the well, had a dy. cap. of 300,000 galls. In '69 an 800,000-gall. pump, built by the Oregon Iron Co., was placed in the station at the river, and in '71 this was supplemented by the 1,000,000-gall. Worthington pump. In '76 the pumping station now known as the round house was built, and the new 3,000,000 gall. placed in it and the 1,000,000-gall. pump moved from the old station, which was then abandoned. In '84 or '85 the Palatine station was built, and the two 5,000,000-gall. pumps placed. It is unofficially reported that a Holly-Gaskill pump was bought in '88.

Reservoir.—Cap., 1,500,000 galls. In '83 two reservoirs were reported, one being 200 ft. sq. by 12 ft. deep, and the other 100 ft. sq. by 15 ft. deep; the first 168, and the second 91 ft. above the pumps.

Distribution.—*Mains*, c. i., 18 miles. *Services*, galv. i. *Taps*, withheld. *Meters*, 42. *Hydrants*, kind not given, 75.

Consumption, 5,000,000. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, $500,000. Bonded debt, $500,000. Int., 5%. Ann. op.exp., $47,500. Ann. rev.: consumers, $95,100; city, $2,400.

Management.—Prest. of operating Com., Henry Failing. Supt., Israel W. Smith. Clerk, T. T. Stubb.

SALEM, *Marion Co.* (Pop., 2,538; est., 6,500.) On Willamette river. Engaged in manufacturing. Settled in '40; incorp. in '46.

History.—Built in '71, and extended in '83 and '87, by Salem Water Co., under 17 years' franchise. J. M. Martin and W. F. Boothby are each accredited as Engr. of the works.

Water Supply.—Williamette river, by direct pumping.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; a Dow water-power and a Davis duplex steam pump.

Distribution.—*Mains*, c. i., w. i., 10½ miles. *Services*, galv. i. *Taps*, 487. *Meters*, none. *Hydrants*, kind not given, 47.

Consumption, not given. *Pressure*: Ordinary, 55 lbs. Fire, 75 lbs.

Financial.—Cost, $135,000. Debt, $21,000. Int., 9%. Ann. op. exp., $3,000. Ann. rev.: total, $12,000. Hydrant rental, $21.84 each.

Management.—Prest., Secy. and Supt., J. M. Martin.

THE DALLES, *Wasco Co.* (Pop., 2,232; est., 5,000.) On Columbia river. Settled in '52; incorp. in '58.

History.—Built in '62 by Robt. Pentland, and now owned by Dalles Mill & Water Co. The city contemplates building works.

Water Supply.—Hood river, by gravity.

Reservoir.—Cap., 50,000 galls.

Distribution.—*Mains*, c. i., w. i., 30 miles. *Services*, galv. i. *Taps*, 700. *Meters*, none. *Hydrants*, kind not given, 16.

Consumption, 2,000,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, to '84, $37,000. Capital stock, $60,000. No debt. Ann. op. exp., not given, but est., $2,000. Ann. rev.: not given, but est., $12,000; city, $100. Hydrant rental, $24.

Management.—Officers: Frank Silsum, D. P. Thompson. Report by Hugh Logan.

NOTE:—The above description of Water Supply, Reservoir and Distribution is subject to correction. The report for '82 gave the source of supply as a mountain stream, a wing-dam diverting a part of the flow into a box conduit of 1½-in. fir plank, 8½ by 10 in., laid underground for 1½ miles to two reservoirs. One of the reservoirs was described as of stone, 16 by 18 ft., by 8 ft. deep, and the other a natural rock basin, 75 by 150 ft., by 12 ft. deep, and 90 ft. above the town.

Water-Works Projected with Fair Prospects of Construction.

ROSEBURCH, *Douglas Co.* (Pop., est., 1,500 to 2,000.) On Umpqua river. Engaged in mining.

Proposed System.—A private company propose to build works in '89, at a cost of from $7,000 to $16,000. Water to be pumped from river to a reservoir.

Present Supply.—Wells for domestic use, small reservoir and two hydrants for fire protection. Report by N. P. Bunnell.

ST. JOHNS, *Multnomah Co.* (Pop., not given.)

General Description.—In '88 a water company had been formed and were sinking a well.

Address Fulton, Cook, Scott & Co.

CALIFORNIA.

Water-Works Completed or in Process of Construction.

ALAMEDA, *Alameda Co.* (Pop., 5,708; est., 10,000.) On San Francisco bay, 8 miles from San Francisco; on level ground surrounded by hills. Settled in '56.

History.—Built in '75 by R. R. Thompson.

Water Supply.—Four artesian wells, gathered in receiving well 30 ft. deep, by pumping to tank, and reservoir and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; a low and a high-pressure Worthington pump, and horizontal Hazelton boilers.

Reservoir.—Cap., 6,000,000 galls.

Tank.—Cap., 250,000 galls.; wrought iron, on top of brick business block, 66 ft. above highest point in city, and 210 ft. above pumps.

Distribution.—*Mains*, c. i., 40 miles. *Services*, galv. i. *Taps*, 1,000. *Meters*, Crown, 550. *Hydrants*, Garrett, 79.

Consumption, 2,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 80 lbs.

Financial.—Cost, $400,000. No debt. Ann. op. exp., withheld, but est., $12,000. Ann. rev.: consumers, $40,000; city, $1,896.

Management.—Owner, R. R. Thompson. Supt., Dell Linderman.

ANAHEIM, *Los Angeles Co.* (Pop., 833; est., 1,100.)

General Description.—Owned by town. Water is pumped through ¾ miles of 4-in. pipe. Hydrants, 8. Address A. Schneider or M. Neblung.

ANDERSON, *Shasta Co.* (Pop., est., 1,200.)

History.—Built in '87-8 by Anderson Water Co. Engr., Ed. Aldersley.

Water Supply.—Mountain stream, by gravity to reservoir.

Reservoir.—Cap., 2,500 galls.

Distribution.—*Mains*, 6-in. riveted w. i. *Services*, ¾-in. *Taps*, not given. *Meters* none. *Hydrants*, kind not given, 9.

Pressure: Ordinary, 75 lbs. Fire, 75 lbs.

Financial.—Cost, $10,000. Capital stock, $10,000. No debt. Ann. op. exp., $1,860. Revenues, not given. Hydrant rental, $600 for all.

Management.—Supt., Ed. Aldersley. Other officers: E. Frisbie, T. C. Brown and J. F. Bedford.

AUBURN, *Placer Co.* (Pop., 2,600.) In mining district.

History.—Built in '87 by Auburn Water-Works Co. Des. Engr., F. Birdsall, Sacramento, Cal. Const. Engr., Wm. Ambrose. Sub-contr., J. Davis.

Water Supply.—Not given.

Reservoir.—Cap., 2,000,000 galls. Is 350 ft. above town.

Distribution.—Not described. Pipe, specials, valves and hydrants furnished by W. W. Montague & Co., San Francisco.

Management.—Supt., F. W. Birdsall.

NOTE:—No further information can be obtained.

AZUSA, *Los Angeles Co.* (Pop., 704; est., 500.)

History.—Built in '87 by Azusa Land & Water Co.

Water Supply.—San Gabriel river, by gravity to reservoir.

Reservoir.—Cap., 1,500,000 galls.

Distribution.—*Mains*, 6-in. c. i., 6 miles. *Services*, 2-in. c. i. *Taps*, *Meters* and *Hydrants*, not given.

Financial.—Cost, not given. Capital stock, $500,000. Debt, not given.

Management.—Prest., J. S. Slauson. Treas., F. C. Howe. Secy., James Slauson.

BENICIA, *Solano Co.* (Pop., 1,794; est., 2,000.) On Sacramento river, on hilly ground sloping to the water. Settled in '47; incorp. a city in '50.

History.—Built in '89 by Benicia Water Co., under 20 years' franchise. Des. Engr., F. A. Gibbes.

Water Supply.—Creeks, by pumping, and by gravity. The first supply is pumped from an impounding reservoir on Sulphur Spring Valley creek, which has a drainage area of 15 sq. m., to a small basin from which it is conveyed by gravity to a distributing reservoir in the village. Later a gravity supply was introduced by building an impounding dam, and in '88 a second dam was built.

PUMPING SYSTEM.

Dam and Reservoir.—Dam is of earth, 280 ft. long, 26 ft. high, 30 ft. wide at top, and with slopes 2½ and 1½ to 1. Reservoir has a cap. of 40,000,000 galls.

Pumping Machinery.—A 250,000-gall. Knowles pump, lifting water 200 ft. to a small basin.

Conduit.—Consists of 12,000 ft. of 7-in. riveted wrought iron.

Distributing Reservoir.—Cap.,1,250,000 galls.; 155 ft. in diam. by 15 ft. deep, at 192 ft. above tide level.

GRAVITY SUPPLY.

First Dam and Reservoir.—Cap., 80,000,000 galls. No further description.

New Dam and Reservoir.—Cap., 200,000,000 galls. No further details given.

The following applies to the whole works.

Distribution.—*Mains*, c. i., w. i., 6 miles. *Services*, w. i. *Taps*, 384. *Meters*, 22. *Hydrants*, kind not given, 44.

Consumption, 100,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, about $150,000. Capital stock, $180,000. Bonded debt, $30,000. Int., 7%. Ann. op. exp., $2,400. Ann. rev.: consumers, $8,400; city, $1,540. Hydrant rental, $48 each.

Management.—Prest., T. M. Kay. Secy. and Supt., E. A. Mizner.

BODIE, *Mono Co.* (Pop., 2,712; est., 1,500.) In mining region.

General Description.—Owned by Bodie Water Co. Water is pumped from a mine to a 180,000-gall. reservoir. Mains, ¾ miles. Hydrants, 9. No other reliable nformation given. Address Wilson Butler or Jas. Glen.

CHICO, *Butte Co.* (Pop., 3,300; est., 5,000.) On Chico creek. Has extensive umber mills.

History.—Built in '75 by Chico Water Co., under 50 years' franchise.

Water Supply.—Surface wells, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Hooker pumps.

Tank.—Cap., about 9,000 galls.

Distribution.—*Mains*, c. i., 4 miles. *Services*, w. i. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 45.

Consumption, 750,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 110 lbs.

Financial.—Cost, $75,000. Capital stock, $100,000. No bonds or debt. Ann. op. exp., $4,000. Ann. rev.: consumers, $12,000; city, $1,920, or about $43 per hydrant.

Management.—Prest. and Gen. Supt., G. W. Dorn. Secy., W. J. Costar.

CLOVERDALE, *Sonoma Co.* (Pop., 430; est., 1,200.)

History.—Built in '85-6 by Riverside Water Co., under 50 years' franchise. Des. Engr., Griffith Coit, San Francisco. Const. Engr., W. D. Sink. Contrs., A. L. Fish & G. Coit, San Francisco, and W. D. Sink, Cloverdale.

Water Supply.—Well, 12 ft. in diam. by 20 ft. deep, pumping to reservoir.

Pumping Machinery.—Dy. cap., 720,000 galls.; Worthington pump.

Reservoir.—Cap., 250,000 galls.

Distribution.—*Mains*, kind not given, 5 miles. *Services*, not given. *Taps*, 140. *Meters*, none. *Hydrants*, Garrett, 15. *Valves*, Garrett.

Consumption, 150,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $15,000. Capital stock, $20,000. No bonds or debt. Ann. op. exp., $1,100. Ann. rev.: consumers, $1,800; city, $300. Hydrant rental, $25 each.

Management.—Treas., Chas. H. Cooley. Supt. and Secy., Carl Ludwig

COLUMBIA, *Cuolumne Co.* (Pop., est., 750.)
History.—Built in '53 by New England Water Co., under 50 years' franchise.
Water Supply.—Springs and Stanislaus river, by gravity.
Reservoirs.—Two, cap., about 45,000 galls each.
Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 85. *Meters* and *Hydrants*, none.
Consumption, 30,000 galls. *Pressure*; 30 lbs.
Financial.—Cost, $23,000. No bonds or debt. Ann. op. exp., $800. Ann. rev.: consumers, $1,300; city, none.
Management.—Supt. and Secy., G. Wing.

COLUSA, *Colusa Co.* (Pop., 1,779; est., 2,000.) On Sacramento river. Settled in '51; incorp. in '70.
History.—Built in '69, and rebuilt in '74 and '88 by J. B. Cooke.
Water Supply.—Sacramento river, pumping to tanks.
Pumping Machinery.—Dy. cap., 500,000 galls.; Knowles pump with 10-in. steam and water cylinders of 14-in. stroke, and Worthington pump, added in '88, with 8-in. high and 12-in. low-pressure steam, and 12-in. water cylinders, all of 10-in. stroke.
Tanks.—Cap., 22,000 and 68,000 galls., respectively; of wood, one 20 and the other 34 ft. in diam., each 10 ft. high. A new tank was projected in '88, to be 80 ft. high.
Distribution.—*Mains*, 8 to 4-in. c. i., 5½ miles; in '87 all wooden mains were replaced with iron. *Services*, iron. *Taps*, 175 *Meters*, 1. *Hydrants*, kind not given, 15.
Consumption, 200,000 galls. *Pressure*: 24 lbs.
Financial.—Cost, $34,000. No debt. Ann. op. exp., $4,000. Ann. rev.: consumers, $7,073; city, $300. Hydrant rental, $20 each.
Management.—Owner and Supt., J. B. Cooke.

CUCAMONGA, *San Bernardino Co.* (Pop., est., 300.)
History.—Built by Cucamonga Water Co., date not given, principally for irrigating purposes. Engr., E. T. Wright, Los Angeles.
Water Supply.—Tunnels into volcanic hill and artesian wells, by gravity, through reservoirs.
Reservoirs.—Five, cap., 2,000,000 to 3,000,000 galls. each.
Distribution.—*Mains*, material not given, 25 miles. *Services*, *Taps*, *Meters* and *Hydrants*, not given.
Financial.—Cost, old works, $200,000.
Management.—Prest., J. C. Lynch.
NOTE.—A contract for extensions and improvements was made in '88, with Lacey, Ward & Co. Work to be completed in two years. No description of the new work can be obtained.

DUTCH FLAT, *Placer Co.* (Pop., est., 500.) On ridge between Bear and American rivers, 3,400 ft. above the sea. Settled in '46.
History.—Built in '59 by an individual, and now owned by Isaac T. Coffin.
Water Supply.—Springs, by gravity from collecting reservoir.
Reservoir.—Cap., about 180,000 galls.; 50 by 60 ft., by 8 ft. deep, and 200 ft. above town.
Distribution.—*Mains*, 13 to 6-in. w. i. and cement, and c. i., 1 mile. *Services*, wood, w. i. *Taps*, 80. *Meters*, none. *Hydrants*, kind not given, 15.
Consumption, 50,000 galls. *Pressure*: 170 lbs.
Financial.—Cost, $5,000. No debt. Ann. op. exp., $400. Ann. rev.: consumers, $1,400; city, $100. When the works were built the town granted a bonus of $2,000, on condition that water was furnished for fire protection, and mains and hydrants kept in repair, natural wear excepted.
Management.—Owner and Supt., Isaac T. Coffin.

ESCONDIDO, *San Diego Co.* (Pop., est., 1,000.)
History.—Built in '87-8 by Escondido Land & Water Co. Engr., E. L. Dorn.
Water Supply.—Three wells, 20 ft. in diam., 12 ft. deep, sunk in bed of river, pumping to reservoir.
Reservoir.—Is 96 by 136 ft., by 12 ft. deep.
Pumping Machinery.—Cap., 1,152,000 galls. Worthington pump, furnished by A. S. Fish, San Francisco.
Distribution.—*Mains*, 6 to 2-in. w. i., 3 miles. Contrs., Crane Bros. Mfg. Co. Chicago, Ill. *Taps*, 75. *Meters* none. *Hydrants* 6.

Consumption, 50,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 60 lbs.

Financial.—Cost, $32,500. Capital stock, authorized, $500,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $1,800; city, not given.

Management.—Prest., J. Greendike. Secy., J. R. Thomas. Mgr., W. W. Thomas Supt., John T. Chambers.

EUREKA, *Humboldt Co.* (Pop., 2,639; est., 7,000.) On Humboldt bay, 7 miles from the ocean. Engaged in lumbering.

History.—Built in '79 by C. S. Hicks, under 15 years' franchise. In '88 the Ricks Eureka Water-Works Co. was incorp. for a term of 50 years, and new works begun.

Water Supply.—Artesian wells, pumping to tank. The wells are respectively 1,293 and 1,105 ft. deep, and at time of report a third was down 802 ft. *New Supply*: Will be brought by gravity from Lawrence creek, 18 miles distant, and a dam constructed, a 20-in. main laid, 1,500 ft. which will be through a tunnel, and a distributing reservoir built near and about 150 ft. above the city. Work was begun in '88.

Pumping Machinery.—Three Knowles pumps, dy. cap., 350,000 galls.

Tank.—Cap., 46,000 galls.

Distribution.—*Mains*, w. i., 7¾ miles. *Services*, w. i. *Taps*, 425. *Meters*, 2. *Hydrants*, kind not given, 6.

Consumption, about 225,000 galls. *Pressure*: 28 lbs.

Financial.—Cost, $50,493. Debt and int., withheld. Ann. op. exp., $3,000. Ann. rev.: consumers, $6,722. Hydrants free.

Management.—Supt., H. L. Ricks.

FRESNO, *Fresno Co.* (Pop., 1,112; est., 10,000.)

History.—Built in '76 by Fresno Water Co. Engr., W. S. Murty, Jr.

Water Supply.—Wells, pumping to tanks. In '85 there were two wells, one 8 and one 10 in. in diam., each 100 ft. deep.

Pumping Machinery.—Dy. cap., 2,750,000 galls.; a 750,000-gall. Holly, and a 2,000,000-gall. Worthington pump.

Tanks.—Cap., 200,000 galls.

Distribution.—*Mains*, c. i., w. i., 12 miles. *Services*, black i. *Taps*, 500. *Meters*, none. *Hydrants*, Garrett, 30. *Valves*, Garrett.

Consumption, 1,000,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, withheld, but est., $100,000. Capital stock, $200,000. Bonds, not given. No floating debt. Ann. op. exp., $10,000. Ann. rev.: consumers, $14,000; city, $600. Hydrant rental, $24 each.

Management.—Prest., Lewis Leach. Secy., J. M. Collier. Supt., J. G. Johnson.

GILROY, *Santa Clara Co.* (Pop., 1,621; est., 2,200.) In a level valley. Settled in '50.

History.—Built in '71-2, and now owned by city. The works were originally owned by a company.

Water Supply.—Uvas river, 11½ miles distant, by gravity to reservoir, with pumping from wells in extreme dry weather. The wells are 11 in. in diam., and 100 and 120 ft. deep, respectively.

Dam.—Not described.

Conduit.—Of hard wood lumber, 18 in. sq., for 6 miles, then of 17 to 13-in. wrought iron pipe for three miles.

Reservoir.—Cap., not given; 2½ miles from and 90 ft. above town.

Pumping Machinery.—A 240,000 gall. Hooker pump.

Distribution.—*Mains*, w. i., 3½ miles; in addition there are 6 miles of wooden conduit and 5½ miles of w. i. conduit and supply mains. *Services*, w. i. *Taps*, (in '82,) 135. *Meters*, none. *Hydrants*, kind not given, 8.

Consumption, unknown. *Pressure*: 40 lbs.

Financial.—The cost of construction was $94,000; city paid $18,000. Bonded debt, $18,000. Int., 7%. Ann. op. exp., withheld, but est., $1,500. Ann. rev.: $3,500 above op. exp., or est., $5,000.

Management.—Supt., Jno. W. Norris. Report by B. A. Wardell.

NOTE:—A vote was taken Jan. 26, '89, on the issuance of $50,000 of 20 years' 5% bonds, to put in cast-iron mains and improve the whole system. Result of vote not given.

GRASS VALLEY, *Nevada Co.* (Pop., 6,688.) In quartz mining and lumbering district, and has manufactories. Settled in '49; incorp. a town in '54.

History.—Built in '66-7 by town, without an Engr.

Water Supply.—South Yuba river, six miles distant, by gravity through open ditch to reservoirs.

Reservoirs.—Three 210 ft. above town; 300 by 500 ft., 100 by 150 ft., and 300 ft. sq., respectively. Depth not given.

Distribution.—*Mains*, 6-in. c. i., 8 miles. *Services*, w. i. *Taps*, 500. *Meters*, none. *Hydrants*, kind not given, 64.

Consumption, "100 inches, miners' measure." *Pressure*: 100 lbs.

Financial.—Cost, $80,000. Debt and int., withheld. Ann. op. exp., $6,600. Ann. rev.: consumers, $8 200; city, none.

Management.—Town Trustees. Gen. Mgr., J. J. Dorsey.

HAYWARDS, *Alameda Co.* (Pop., 1,231; est., 2,000.)

History.—Built in '88 by Knox Bros., under a 50 years' franchise.

Water Supply.—Wells, pumping to reservoir and direct.

Reservoirs.—Cap., 650,000 galls.; 52 by 100 ft. by 16 ft., lined with cement. Is 160 ft. above town.

Pumping Machinery.—Cap., 600,000 galls. Contrs., Dow Steam Pump Works, San Francisco.

Distribution.—*Mains*, 8 to 4-in. black i., 5 miles. *Services*, not given. *Taps*, 60. *Meters*, from San Francisco Tool Co., 6. *Hydrants*, kind not given, 22.

Pressure: Ordinary, 50 to 70 lbs. Fire, 60 to 80 lbs.

Financial.—Not given.

Management.—Owner, W. Knox.

HEALDSBURCH, *Sonoma Co.* (Pop., 1,133; est., 3,500.) On Russian river.

History.—Built by F. & A. Koenig. under a 50 years' franchise.

Water Supply.—Springs, pumping to reservoir.

Pumping Machinery.—Dy. cap., 500,000 galls.; Blake pump and 40 H. P. boiler.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, 6-in. i., 3 miles. *Taps*, 200. *Meters*, none. *Hydrants*, 12. Further details not given.

Financial.—Cost, $30,000. No debt. Ann. op. exp., $600. Ann. rev.: withheld, but est., $4,000.

Management.—Supt., F. Koenig.

HOLLISTER, *San Benito Co.* (Pop., 1,034; est., 2,000.) Settled in '70.

History.—Built in '76 by private company, name not given, under 50 years' franchise. Des. Engr., R. M. Shackelford.

Water Supply.—Three artesian wells, pumping to reservoir. Each well is 10 in. in diam. and 85 ft. deep.

Pumping Machinery.—A 500,000-gall. Knowles pump, with 15½-in. steam and 10-in. water cylinders, and two tubular boilers.

Reservoir.—Cap., 300,000 galls.; in excavation, lined with brick in cement, at 120 ft. above town.

Distribution.—*Mains*, c. i., w. i., 6½ miles. *Services*, w. i. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 38.

Consumption, 150,000 galls. *Pressure*: 47 lbs.

Financial—Cost, "unknown," but est., $60,000. Capital stock and bonded debt, withheld. Ann. op. exp., withheld, but est., $3,000. Ann. rev.: consumers, $8,000. Hydrants free.

Management.—Prest., W. S. McMurtry, Jr., Fresno. Supt., Jas. L. Allen.

INDEPENDENCE, *Inyo Co.* (Pop., est., 250.)

History.—Built in '87 by Independence Water Co., under 50 years' franchise. Engr., S. D. Thurston.

Water Supply.—Pinyon and Pine creeks, by gravity.

Distribution.—*Mains*, spiral riveted w. i., 2 miles. *Services*, w. i. *Taps*, 80. *Meters*, none. *Hydrants*, kind not given, 5.

Consumption, 20,000 galls.

Financial.—Cost, $6,000. Ann. op. exp., $500. Ann. rev.: consumers, 1,200; city not given. Hydrant rental, $24 each.

Management.—Prest., E. Robinson. Secy., A. R. Conklin. Supt., S. D Thurston.

INGLEWOOD, *Los Angeles Co.* (Pop., est., 400.)

History.—Built in '87-8 by Centilera-Inglewood Land Co. Des. Engr., Wm. Hall, Sacramento. Const. Engr., C. H. Kluegel, Ontario, Cal.

Water Supply.—Inglewood springs, developed by excavation and artesian wells, pumping to reservoir. The springs have a flow of 1,000,000 in 24 hours.

Pumping Machinery.—Worthington pump, cap., 900,000 galls.

Reservoir.—Cap., 500,000.

Distribution.—*Mains*, riveted w. i., with screw joints, 15 miles. Contrs. for pipe, specials, trenching and pipe-laying and valves and hydrants, Lacy, Ward & Co., Los Angeles.

Pressure: 90-ft. head.

Financial.—Cost., $39,000.

Management—Prest., L. A. Sheldon. Secy., E. J. Cox. Supt., A. M. Rollins.

NOTE:—No further information given.

JACKSON, *Amador Co.* (Pop., 1,040; est., 1,500.) In mining region.

History.—Built in '65; now owned by B. F. Richtmyer. No Engr. employed.

Water Supply.—Springs, and Blue Lakes Water Co.'s canal, mode not given, but water passes to reservoir from former and to tank from latter.

Reservoir and Tank.—Not described.

Distribution.—*Mains*, 6-in., material not given, 2½ miles. *Services*, not given. *Taps*, 131. *Meters*, none. *Hydrants*, kind not given, 7.

Consumption, not known. *Pressure*: 170 ft. head.

Financial.—Cost, unknown, but est., $25,000. No debt. Ann. op. exp., $90). Ann. rev.: consumers, withheld, but est., $4,000; city, not given.

Management.—Proprietor and Supt., B. F. Richtmyer.

LAGONIA, *San Bernardino Co.* (Pop., est., 400.) See Redlands.

LIVERMORE, *Alameda Co.* (Pop., 855; est., 2,000.)

History.—Built in '75-6 by Aylward & Mullany, and known as Livermore Spring Water Co. Franchise was for 50 years. Des. Engr., W. F. Boardman.

Water Supply.— Livermore springs pumping to reservoirs, and Arroyo Mocho river, by gravity. Pumping is used for six or seven months of the year, and the gravity supply the remainder.

Pumping Machinery.—Dy. cap., 480,000 galls.; made by Aylward's Agricultural Works, Livermore.

Reservoirs.—Cap., 1,000,000 galls.; three, in excavation, puddled.

Distribution.—*Mains*, riveted w. i., 12 miles. *Services*, not given. *Taps*, 400. *Meters*, not given. *Hydrants*, New York, 15. *Valves*, Garrett.

Consumption, 80,000 galls. *Pressure*; Ordinary, 25 lbs.

Financial.—Cost, $35,000. Debt, $3,700. Int., 8%. Ann. op. exp., $360. Ann. rev.: consumers, withheld, but est., $10,000. Hydrants free.

Management.—Supt., Jno. Aylward.

LOS ANGELES, *Los Angeles Co.* (Pop., 11,183; est., 50,000.) On Los Angeles river, at an elevation of 100 to 309 ft. Incorp. a city in '58.

LOS ANGELES CITY WATER CO.'S SYSTEM.

History.—Begun in '62 and rebuilt or extended in '68-9, under a 30 years' franchise. Contrs., Harper & Reynolds Co., Los Angeles.

Water Supply.—Los Angeles river, by gravity.

Wing Dam and Ditch.—Dam is of brush and sand, extending into river to divert water to an open ditch, 7 miles long, leading to reservoir.

Dam and Reservoir.—Cap., 15,000,000 galls.; dam is of masonry, across a canyon, but is not further described. The reservoir was increased in size in '82 by excavating its bottom to solid rock. Previously its cap. was 7,000,000 galls.

Distribution.—*Mains*, c. i., w. i., 240 miles. Cement lined sheet iron mains have been used, but did not give satisfaction. *Services*, galv. i. *Taps*, 6,600. *Meters*, 150. *Hydrants*, Ludlow, 136. *Valves*, Ludlow.

Consumption, 5,000,000 galls. *Pressure*: 100-ft. head.

Financial.—Cost, withheld. Capital stock, $1,200,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., $18,000. Ann. rev.: consumers, $200,000. Hydrants free.

Management.—Prest., Wm. H. Perry. Secy., S. H. Mott. Supt., Wm. Mulholland.

CITIZENS' WATER CO.'S SYSTEM.

History.—Built in '73-4, under 50 years' franchise. Centrs., Harper & Reynolds Co., Los Angeles. The water company now does its own work.

Water Supply.—Los Angeles river, by gravity and by pumping to reservoirs. The gravity supply has a head of 438 ft.

Pumping Machinery.—Dy. cap., not given; a Worthington and a Hooker pump.

Filter.—Hyatt, dy. cap., 300,000 galls.

Reservoirs.—Three, cap., 5,000,000 galls. The highest reservoir has an elevation of 580, and the lowest of 445 ft.

Distribution.—*Mains*, c. i., w. i., 100 miles. *Services*, galv. i. *Taps*, 1,871. *Meters* and *Hydrants*, *Consumption* and *Pressure*: not given.

Financial.—Cost, $375,000. Debt, $200,000. Int., 6%. Ann. op. exp., $41,000. Ann. rev.: consumers, est., $59,000.

Management.—Secy., J. W. Anderson. Supt., Johnson Reynolds.

NOTE:—Most of the above information was obtained from the companies by Burr Bassell, Los Angeles.

MENLO PARK, *San Mateo Co.* (Pop., 225.)

History.—Built in '64 by Menlo Park Water Co.

Water Supply.—Surface water, by gravity.

Reservoir.—Cap., 125,000,000 galls.; covers 5 acres.

Distribution.—*Mains*, w. i., 11 miles. *Services*, w. i. *Taps*, 125. *Meters*, 32. *Hydrants*, none.

Consumption, unknown. *Pressure*: Ordinary, 40 lbs. Fire, 60 lbs.

Financial.—Cost, $250,000. Capital stock and bonds, not given. No floating debt. Ann. op. exp., withheld, but est., $2,000. Ann. rev.: consumers, withheld, but est., $5,000; city, none.

Management.—Prest., C. N. Felton. Secy., L. C. Frazee. Supt., D. J. Mills.

MERCED, *Merced Co.* (Pop., 1,446; 4,000.)

History.—Built in '80-1 by W. L. Sillman & J.J. Stevenson, under 25 years' franchise.

Water Supply.—Artesian well, 160 ft. deep, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Knowles pump.

Tank.—Not described.

Distribution.—*Mains*, w. i., 3¾ miles. *Services*, w. i. *Taps*, 212. *Meters*, not given. *Hydrants*, 4.

Consumption, 100,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 75 lbs.

Financial.—Cost, $12,500. Capital stock, $12,000. No debt. Ann. op. exp., $1,800. Ann. rev.: consumers, $5,000; city, $200. Hydrant rental, $50 each.

Management.—Supt., A. C. Swain.

MISSION SAN JOSE, *Alameda Co.* (Pop., 246.)

History.—Built in '70 by company.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 100,000 galls.

Distribution.—*Mains*, w. i. ½ miles. *Taps*, 32. *Hydrants*, 12.

Consumption, 20,000 galls.

Financial.—Cost, withheld, but est., $4,000. Ann. op. exp., about $40. Ann. rev.: consumers, about $600.

Management.—Supt., Juan Galleges.

MODESTO, *Stanislaus Co.* (Pop., 1,693; est., 3,200.) On generally level land ½ mile from Tuolumne river. Settled in '70.

History.—Built in '76 by Modesto Water Co., under 50 years' franchise. Des. Engr., Jno. Hamilton.

Water Supply.—Artesian wells, pumping to tanks. There are two 10-in. wells, each 116 ft. deep, having a dy. yield of 1,200,000 galls.

Pumping Machinery.—Dy. cap., not given; two Blake pumps, one with 10-in. steam and 9-in. water cylinder of 12-in. stroke, and the other with 12-in. steam and 8-in. water cylinder of 14-in. stroke.

Tanks.—Cap., 100,000 galls.; 112 ft. above pumps.

Distribution.—*Mains*, w. i., 8 miles. *Services*, w. i. *Taps*, 450. *Meters*, none. *Hydrants*, 5.

Consumption, 400,000 galls. *Pressure*: 30 lbs.

Financial.—Cost, $10,000. Capital stock, $20,000. Undivided profit, $20,000. No debt. Ann. op. exp., $8,086. Ann. rev.: consumers, $9,500; city, $525. Hydrants free.

Management.—Prest. and Supt., Robt. McHenry. Secy., Ora McHenry.

MONTEREY, *Monterey Co.* (Pop., est., 1,400.) On Monterey bay. See Pacific Grove.

NAPA CITY, *Napa Co.* (Pop., 3,731; est., 5,000.) On Napa river, in valley between high hills. Settled about '54; incorp. a city in '74.

History.—Built in '83-4 by Napa City Water Co. Des. Engr., G. F. Allardt. Const. Engr., O. H. Buckman. Labor done by local parties.

Water Supply.—Surface well, pumping to reservoir. In dry weather the river is drawn upon. The well is 5 ft. in diam. by 47 ft. deep, and from a point 40 ft. below the surface a tunnel 6 ft. high and 4 ft. wide extends through volcanic rock for 126 ft. to a point beneath a saturated gravel stratum, with which it connects.

Pumping Machinery.—Dy. cap., 720,000 galls.; compound Harper pump, made by W. T. Garrett & Co., having 12 and 20-in. steam and 12-in. water cylinders of 20 in. stroke.

Dam.—Across ravine to form reservoir of masonry, 167 ft. long, 33 ft. high, 22¼ ft. wide at the bottom and 7 at the top.

Reservoir.—Cap., 2,500,000 galls.; 100 ft. above main street of city.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe and specials from R. D. Wood & Co., Philadelphia, Pa. *Taps*, 540. *Meters*, 12. *Hydrants*, Garrett, 40. *Valves*, Garrett. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*: 45 lbs.

Financial.—Cost, $125,000. Capital stock, $150,000. No bonds or debt. Ann. op. exp., est., $6,000. Ann. rev.: consumers, est., $12,000; city, about $1,200. Hydrant rental, $25 each.

Management.—Prest., S. E. Holden. Secy., E. S. Churchill. Supt., T. R. Parker.

NATIONAL CITY.—(Pop., 387; est., 6,900.) On San Diego bay. Has railway repair shops.

History.—Built in '86-8 by San Diego Land & Town Co., of Boston, Mass. Engr., Jas. D. Schuyler.

Water Supply.—Sweet Water river, by gravity from impounding reservoir, formed by dam across river.

Sweet Water Dam.—Is 98½ ft. high, 46 ft. thick at bottom, 12 ft. thick at top, 360 ft. long on crest, of curved type, with a radius of 213 ft. The masonry is of rough rubble, laid in Portland cement and sand in the proportion of 1 to 3. Illustrations and a full description of this dam will be found in *Engineering News*, vol. XIX., pp. 270-1.

Reservoir.—Cap., 6,000,000,000 galls. Has an area of 720 acres, is 3 miles long by ¾ miles wide.

Distribution.—*Mains*, w. i., 63¼ miles; from National Tube Works Co., McKeesport, Pa. *Services*, galv. i. *Taps*, 200. *Meters*, none. *Hydrants*, not given.

Consumption, 2,000,000 galls. *Pressure*: 60 to 80 lbs.

Financial.—Cost, $735,813. Capital stock, including "land, railroad, water-works and other enterprises," $2,250,000. Debt, not given.

Management.—Gen. Mgr., Wm. G. Dickinson. Report by J. D. Schuyler.

NEVADA CITY, *Nevada Co.* (Pop., 4022; est., 6,000.) On Deer creek in mountainous mining region. Engaged in lumbering and manufacturing.

History.—Built in '61 by private company.

Water Supply.—South Yuba river, by gravity.

Reservoirs.—Three. cap., 1,000,000 galls.; 212 ft. above city.

Distribution.—*Mains*, c. i., 4½ miles. *Services*, galv. i. *Taps*, 400. *Meters*, 4. *Hydrants*, 41.

Consumption, 680,000 galls. *Pressure*: 212 ft. head.

Financial.—Cost, $38,000. No debt. Ann. op. exp., $4,800. Ann. rev.: consumers, $12,000; city, $4,100. Hydrant rental, $100.

Management.—Supt., J. E. Brown.

NIPOMO, *San Luis Obispo Co.* (Pop., est., 500.)

History.—Built in '87 by Nipomo Water Co. Des. Engrs., S. A. Dana and P. Fry

Const. Engr., A. H. Armstrong. Sub-Contrs., A. Dixie and Y. S. Runels & Sons.

Water Supply.—Mountain springs, by gravity to reservoir.

Reservoir.—Cap., 22,000 galls.; 70 ft. sq. by 6 ft. deep.

Distribution.—*Mains*, 4 in., 2 miles. *Services*, not given. *Taps*, 99. *Meters* and *Hydrants*, not given.

Consumption, 50,800 galls. *Pressure*: not given.

Financial.—Cost, $22,000. Capital stock, $25,000. Debt, $1,600. Int., 7%. Ann. op. exp., $800. Ann. rev.: consumers, $1,900; city, none. Hydrant rental, free.

Management.—Prest., A. H. Armstrong. Secy., S. A. Dana. Supt., Wesley Adams.

OAKLAND, *Alameda Co.* (Pop., 34,555; est., 45,000.) On San Francisco bay, on flat, low, sandy ground; back of the city hills rise to a height of 1,500 ft. Settled in '51; incorp. a city in '54.

History.—Built in '66 by Contra Costa Water Co. No special franchise. Des. Engr., Anthony Chabot. Const. Engr., W. F. Boardman.

Water Supply.—Artificial lakes, by gravity to reservoirs, and artesian wells, by pumping to reservoir to supply highest parts of city. The lakes have a combined drainage area of 49 sq. m.

Dams.—Two, of earth, built across creeks. That forming Lake Chabot is 300 ft. long, 80 ft. high, and 310 ft. wide at the base. The second dam is not described.

Lake Chabot.—Cap., 5,000,000,000 galls.; covers 400 acres, drains 44 sq. m. and is 200 ft. above city. It is unofficially reported that in '83 a 2,000,000-gall. filter basin was put in near this lake.

Seneschal Lake.—Cap., 270,000,000 galls.; covers 18 acres, drains 5 sq. m., and is 400 ft. above city.

Conduit.—In '82 water passed from Lake Chabot through screens formed by tacking cotton cloth on frames, into a 24-in. asphalt coated, riveted wrought iron pipe leading to distributing reservoir.

Distributing Reservoirs.—Three, cap., 1,000,000 galls. each.

Pumping Machinery.—Dy. cap., 500,000 galls.; Cameron deep-well pumps, lifting water from wells to reservoir for high service.

Distribution.—*Mains*, c. i., w. i. and cement, 164 miles. Previous to '78 distribution was wholly by w. i. and cement pipe. In '82 it was stated that the preference was for boiler-iron riveted pipe, coated with asphalt and lined with cement. *Services*, galv. i. *Taps*, 7,400. *Meters*, 150. *Hydrants*, Chabot, 21.

Consumption, 7,000,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 50 to 90 lbs.

Financial.—Cost, $5,200,000. Capital stock, $3,000,000. Debt, $1,075,000, of which $900,000 is in bonds. Int., 6%. Ann. op. exp., $120,000. Ann. rev.: consumers, $260,000; city, $20,000. Hydrant rental, $60 each.

Management.—Prest., Henry Tierce. Secy., Wm. H. Mead. Supt., Chas. Purcell.

OCEANSIDE, *San Diego Co.* (Pop., est., 1,200.) Not incorp.

History.—Built in '86 by Oceanside Water Co., under the direction of the officers. Labor done by company.

Water Supply.—River, pumping to reservoir.

Pumping Machinery.—Dy. cap., 69,000 galls.; make not given.

Reservoir.—Cap., about 150,000 galls.

Distribution.—*Mains*, w. i., 5 miles. *Services*, w. i. *Taps*, 44. *Meters*, none. *Hydrants*, none.

Consumption, not given. *Pressure*: 92 lbs.

Financial.—Cost, about $10,000. Capital stock, $12,000. No debt. Ann. op. exp., for '86, $700. Ann. rev.: consumers, for '86, $800; city, none.

Management.—Prest., A. J. Meyers. Secy., J. E. Meyers. Supt., E. W. Scott.

ONTARIO, *San Bernardino Co.* (Pop., est., 2,000.) On San Antonio river.

History.—Built in '83 by San Antonio Water Co. Engr., J. C. Dunlap, Los Angeles. Des. Engr. for late improvements and extensions, Geo. Chaffer; Const. Engr for same, F. E. Trask.

Water Supply.—San Antonio creek, by gravity through tunnel. A large part of the water is used for irrigation.

Tunnel.—Not described.

Distribution.—*Mains*, c. i. and cement, 80 miles, mostly for irrigating purposes.

Services, w. i. *Taps* and *Meters*, not given. *Hydrants* and *Valves*, from Harper & Reynolds Co., Los. Angeles, number not given.

Consumption, 3,000,000 galls. *Pressure*: 150 lbs.

Financial.—Cost, $300,000. Capital stock, $1,500,000. No debt. Ann. op. exp., $2,000. Ann. rev.: consumers, $2,450; town, $800.

Management.—Prest., S. P. Hildreth. Secy., W. J. Waddingham. Engr. and Supt., F. E. Trask.

OROVILLE, *Butte Co.* (Pop., 1,743; est., 2,000.) On Feather river. Not incorp.

History.—Built in '78 by Oroville Water Co. No Engr. employed.

Water Supply.—Butte creek, by gravity through mining canal to reservoir, the supply being purchased from the Thermalito Colony Co.

Reservoir.—Cap. 2,000,000 galls.

Distribution.—*Mains*, sheet iron, 5 miles. *Services*, w. i. *Taps*, 220. *Meters*, 1. *Hydrants*, kind not given, 35.

Consumption, 600,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $30,000. Capital stock, $50,000. Ann. op. exp., $3,500. Ann. rev.: consumers, withheld, but est., $6,600; city none. Hydrants, free.

Management.—Prest., Jno. J. Smith. Supt., D. N. Friesleben.

PACIFIC GROVE, *Monterey Co.* (Pop., not given.)

History.—Built in '83 by Pacific Improvement Co., Fourth and Townsend Sts., San Francisco, to supply Hotel del Monte, and incidentally Monterey, Pacific Grove and vicinity. Engr., Arthur Brown, West Oakland.

Water Supply.—Carmel river, by gravity to reservoirs.

Reservoirs.—Combined cap., 157,000,000 galls.; 140,000,000 and 17,000,000 galls. respectively.

Distribution.—*Mains*, 24 to 6-in. c. i., w. i., 26 miles. Contrs., Huntington Hopkins Co., San Francisco. *Services, Taps, Meters*, and *Hydrants*, not given.

Consumption, 250,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 173.

Financial.—Withheld.

Management.—Prest., J. H. Strobridge. Secy. and Mgr., F. S. Douty, Fourth and Townsend Sts., San Francisco. Supt., I. A. Skinner.

PASADENA, *Los Angeles Co.* (Pop., est., 9,000.)

NORTH PASADENA LAND AND WATER CO.

History—Built in '69-71. Supplies a pop. of 1,500.

Water Supply.—Arroy Seco river and branches to reservoirs.

Reservoirs.—Two; combined cap., 1,200,000 galls. First, 450,000 galls; 50 by 100 ft., by 12 ft. deep. Second, 750,000 galls.; 150 ft. sq. by 10 ft. deep.

Distribution.—*Mains*, 12 to 4-in. c. i. and cement, 20 miles., from J. D. Hooker & Co., and Lacy, Ward & Co., Los Angeles. *Services*, not given. *Taps*, 300. *Meters*, none. *Hydrants*, not given.

Consumption, 100,000 to 150,000 galls. *Pressure*: 10 to 100 ft.-head.

Financial.—Cost, $54,000. Capital stock authorized $90,000; $54,000 paid up. No debt. Ann. op. exp., $2,500. Ann. rev.: consumers, $2,500; city, not given.

Management.—Prest., Geo. W. Hayes. Secy. and Treas., M. D. Painter. Supt., J. L. Simmons.

THE PASADENA LAND AND WATER CO.

History.—Built in '74. The franchise is for 50 years' from '83. Supplies water to 2,500 of the pop. of Pasadena and 1,000 of South Pasadena.

Water Supply.—Springs in the Arroy Seco, pumping to reservoirs.

Pumping Machinery.—Cap., 792,000 galls.; Worthington compound pump.

Reservoirs.—Combined cap., 4,000,000; 3,000,000 and 1,000,000 galls., respectively.

Distribution.—*Mains*, c. i., w. i., 10 miles. Contrs., L. W. Dennis and Lacy, Ward & Co., both of Los. Angeles, and R. Heretig & Co., Pasadena. *Taps*, 750. *Meters*, "very few." *Hydrants*, about 12.

Pressure; 60 to 100-ft. head.

Financial.—Cost, $85,000. Capital stock, $75,000. No debt. Ann. op. exp., $4,400. Ann. rev.: consumers, $6,000; city, none.

Management.—Prest., O. R. Dougherty. V. Prest., E. Turner. Secy., H. G. Bennett. Treas., S. Washburn. Supt., W. J. Barcus.

PETALUMA, *Sonoma Co.* (Pop., 3,326; est., 4,000.) On Petaluma creek, 10 miles from San Pablo bay, in a valley surrounded by hills. Has manufactories. Settled in '52; incorp. in '57.

History.—Built in '71 by company. Des. Engrs., Thomas Bros. Contr., M. J. Miller.

Water Supply.—Mountain streams draining 20 sq. m., by gravity to reservoir.

Conduit.—Of 7-in. riveted wrought-iron pipe, leading to reservoir.

Reservoir.—Cap., 2,500,000 galls.; 150 ft. sq., in excavation and embankment, lined with brick, at 175 ft. above town.

Distribution.—*Mains*, c i., riveted w. i., 17 miles. *Services*, w. i. *Taps*, 775. *Meters*, 3. *Hydrants*, Savage & Sons, 31. *Valves*, Chapman.

Consumption, 140,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 70 lbs.

Financial.—Cost, $140,000. Capital stock, $300,000. Bonded debt, $20,000. Int., 5%. Ann. op. exp., $1,243. Ann. rev.: consumers, $18,468; city, $1,336. Hydrant rental, $30.

Management.—Prest., Wm. Hill. Supt. and Secy., F. P. Doyle.

PLACERVILLE, *El Dorado Co.* (Pop., 1,951; est., 2,200.) In gold mining region.

History.—Built by company, date not given.

Water Supply.—Mining canal, by gravity to reservoirs.

Reservoirs.—Two, cap., 500,000 galls.

Distribution.—*Mains*, 7 to 3-in., 3½ miles. *Hydrants*, 18.

Pressure: Ordinary, 47 lbs. Fire, 150 lbs.

Management.—Address G. W. Barlow or Robt. Motzer.

NOTE:—No returns have been given for '88.

POMONA, *Los Angeles Co.* (Pop., est., 5,000.)

General Description.—Built in 82-3, by Pomona Water-Works Co. Supply is from artesian wells, by gravity. Est. cost, $150,000.

Management.—Prest., B. S. Nichols. Secy., F. L. Palmer.

PORTERSVILLE, *Tulare Co.* (Pop., est., 600.)

History.—Built in '88 by Pioneer Land Co., San Francisco. Engr., Emil Newman, Portersville.

Water Supply.—Tube river, by gravity to pump, thence by pumping to standpipe and tank. Water is conveyed by gravity through a ditch 8 miles in length, then filtered, and after passing to a well is pumped to a large air chamber connected with the force main.

Filter.—Not described.

Pumping Machinery—Cap., 50,000 galls. Water-power pump, from J. B. Jordine, driven by a 33 H. P. Leffel mining water wheel.

Tank.—Cap., 30,000 galls.; built by company.

Distribution.—*Mains*, 6-in. coated w. i., 1½ miles. *Services*, w. i. *Taps* and *Meters*, not given. *Hydrants*, kind not given, 7.

Pressure: Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, est., $9,500. Capital stock, $250,000.

Management.—Prest., W. Thomas, 206 Sansome St. Secy., Louis Kose, Jr., 310 Sansome St. Both of San Francisco. Engr., E. Newman.

RED BLUFF, *Tehama Co.* (Pop., 2,106; est., 3,500.) On terrace of red, gravelly loam, 60 ft. above Sacramento river. Settled in '50; incorp. a city in '74.

History.—A small system was built in '61 by a private company, and the present works in '80 by S. H. Jewett, Peter Decker and Chas. Cadwalader, and known as Antelope Creek & Red Bluff Water Co. There is no franchise. Built under direction of C. Cadwalader.

Water Supply.—Antelope creek, nine miles distant, by gravity, and Sacramento river, by direct pumping. The river water was originally pumped to a settling basin, then repumped by Garrett pumps into four tanks with a cap. of 45,000 to 55,000 galls. each, and to stand-pipe.

Stand-Pipe.—Cap., 18,900 galls.; 8 ft. in diam. and 50 ft. high.

Dam and Impounding Reservoir.—On creek, 100 ft. above city, the dam being of timber. An 8-in. wrought-iron pipe leads to the city.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Hooker pumps and 40 H. P. boiler.

Distribution.—*Mains*, riveted and lap-welded w. i., 17 miles. *Services*, galv. i. *Taps*, 350. *Meters*, none. *Hydrants*, kind not given, 30.

Consumption, 1,500,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 40 lbs.

Financial.—Cost, to '83, $100,000. No stock, bonds or debt. Ann. op. exp., withheld, but est., $4,000. Ann. rev.: consumers, withheld, but est., $14,000; city, $540. Hydrant rental, $18 each.

Management.—Supt., Chas. Cadwalader.

REDDING, *Shasta Co.* (Pop., est., 3,000.) In mining and lumbering district.

General Description.—In '88 the Redding Water Co. were substituting a steam pump for a water wheel, placed on pontoons, for lifting water 90 ft. to a reservoir. Address S. P. Filiman or B. F. Roberts.

NOTE:—No further information can be obtained.

REDLANDS, *San Bernardino Co.* (Pop., est., 900.)

History.—Built in '87-8 by Redlands, Lugonia & Crafton Domestic Water Co. Engr., E. A. Tuttle.

Water Supply.—Bear Valley reservoir, Santa Ana river and Mill creek by gravity, through ditches, 5 to 20 miles long, to distributing reservoir. Water is furnished to the towns of Redlands, Lugonia and Crafton, for domestic use, and also for irrigation

Bear Valley Dam.—Built in '83-4. Engr., F. E. Brown. It is supposed to be the boldest specimen of arch dam, without gravity stability, in the world. It is 20 ft. thick at the base, 38 in. at the top, 64 ft. high, 300 ft. long, with a radius of 335 ft. It is of granite in cement, the granite having been quarried near the dam.

An earth dam 6 ft. high was first built, 2½ miles above the proposed dam, stopping the flow of the water, and flooding 450 acres, at a depth of 5 ft. As work on the dam proper progressed, water was let in against it from this surface dam, to bring the pressure to bear upon the arch before the cement had set very hard, and thus let the whole arch take its bearings and transmit the pressure to the mountains at its ends.

Being thus built, it is difficult to detect any movement of the wall on account of pressure. The dam cost $75,000. In '88, it was to be raised to a height of 80 ft.; the addition to be built on a curve, but with a gravity section. Further details and illustrations showing status of work at different stages of its construction, together with editorial comments, will be found in *Engineering News*, vol. 19, pp. 271-2, 513-17.

Bear Valley Reservoir.—Cap., 10,000,000,000 galls. Formed by masonry dam across canyon. Is 5½ miles long, 300 to 1,300 ft. wide and 10 to 52 ft. deep. It is at an elevation of 6,000 ft., 18 miles northeast of Redlands.

Distribution.—*Mains*, 12 to 6 in. w. i., sheet i., 24 miles. *Services*, ¾-in. w. i. *Taps*, 250; Redlands, 175; Lugonia, 75. *Meters*, none. *Hydrants*, none.

Consumption, 450,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 104 lbs.

Financial.—Cost, $200,000; for works, $80,000; for water rights, $120,000. Capital stock, $500,000; $200,000 paid up. No debt. Ann. op. exp., $3,000. Ann. rev.: consumers, $6,000; city, none.

Management.—Prest., Geo. A. Cook. Secy., Fulton G. Feraud. Supt., H. W. Allen.

REDWOOD CITY, *San Mateo Co.* (Pop., 1,383; est., 1,800.) On Redwood creek.

History.—Built in '77 by town. Contr., Jas. Cody, deceased.

Water Supply.—Salinas Water-Works Co.'s system, pumping to tanks. The supply at Salinas is from artesian wells.

Pumping Machinery.—A 600,000-gall. Thompson & Evans pump.

Tanks.—Three, cap., 46,000 galls. each.

Distribution.—*Mains*, 8 to 4-in., material not given, 4 miles. *Services*, not given. *Taps*, 254. *Meters*, 21. *Hydrants*, kind not given, 35.

Consumption, 75,000 galls. *Pressure*: not given.

Financial.—Cost, $25,000. Debt, $8,000. Int., 6%. Ann. op. exp., $2,200. Ann. rev.: consumers, not given, but est., $6,000; city, none.

Management.—Supt., Jos. Stalter.

RIVERSIDE, *San Bernardino Co.* (Pop., 1,358; est., 6,000.) On Santa Ana river.

History.—Water-works proper built in '86-7 by Riverside Water Co. Irrigating em established in '71 by same company. Engr., G. O. Newman.

Water Supply.—Artesian wells for domestic use, river for irrigation, by gravity reservoir.

Reservoir.—Not described.

Distribution.—*Mains*, 16 to 8-in. w. i., 17 miles. *Taps*, about 400. *Meters*, none. *Hydrants*, 3.

Pressure: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $300,000 for domestic and $450,000 for irrigating works. Capital stock, $300,000. Debt, $360,000; of which $335,000 is in bonds. Int., 6%. Ann. op. exp., for both systems, about $3,000. Ann. rev.: consumers, $31,000; mostly for irrigating works; city, not given.

Management.—Prest., John G. North. Secy., D. Carroll. Engr., G. O. Newman. Supt., Francis Cuttle. Report by Dr. J. Jarvis.

SACRAMENTO, *Sacramento Co.* (Pop., 21,420; est., 35 000.) On level ground at junction of American and Sacramento rivers. The city is now about 8 ft. above ordinary high water. Settled in '39; incorp. a city in '49.

History.—Built in '54 by city.

Water Supply.—Sacramento river, pumping to tank and direct.

Pumping Machinery.—Dy. cap., 7,000,000 galls.; a 3,000,000-gall. Holly pump, erected in '84, and a 4,000,000-gall. pump since designed and constructed by A. J. Stevens.

Tank.—Is 81½ by 84½ ft.

Distribution.—*Mains*, c. i., w. i., 35 miles. *Services*, w. i. *Taps*, 4,600. *Meters*, none. *Hydrants*, kind not given, 369.

Consumption, 6,000,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 60 lbs.

Financial.—Cost, $350,000. No debt reported. Ann. op. exp., $25,000. Ann. rev.: consumers, $68,500; city, $60,000.

Management.—Three Trustees. Supt., H. C. Wolf. Chf. Engr., E. H. Williams.

SAINT HELENA, *Napa* Co. (Pop., 1,339; est., 2,500.)

History.—Built in '77-8 by St. Helena Water Co.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., 30,000,000 galls.

Distribution.—*Mains*, w. i., 5 miles. *Services*, w. i. *Taps*, 195. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, 200,000 galls. *Pressure*: about 65 lbs.

Financial.—Cost, $40,912. Capital stock, authorized, $50,000; paid up, $40,250. No bonds or debt. Ann. op. exp., $700. Ann. rev.: consumers, $4,200; city, $400. Hydrant rental, $12.

Management.—Prest., W. A. C. Smith. Secy., F. S. Ewer. Supt., Seneca Ewer.

SALINAS, *Monterey Co.* (Pop., 1,854; est., 3,500.) Settled in '68; incorp. a city in '74.

History.—Built in '74-5 by Salinas Gas & Water Co. Engr., Jos. Enright, San Jose. Principal contr., Wm. White, Portland, Ore.

Water Supply.—Seven 6 in. artesian wells, pumping to tanks. The first three wells are 80, 200 and 234 ft. deep, respectively.

Pumping Machinery.—Dy. cap., 360,000 galls.; compound Knowles pumps.

Tanks.—Three; two of 90,000 galls. cap. each, at 45 ft. above city, and one of 40,000 galls. cap., at 75 ft. above city. The latter is for fire protection.

Distribution.—*Mains*, c. i., 5 miles. *Services*, w. i. *Taps*, (in '84,) 250. *Meters*, (in '84,) 2. *Hydrants*, Standard Olympia, 24.

Consumption, 60,000 galls. *Pressure*: Ordinary, 31 lbs. Fire, 40 lbs.

Financial.—Cost, not given, but est., $40,000. No debt. Ann. op. exp., in '84, $1,000. Ann. rev.: consumers, withheld, but est., $7,500; city, not given.

Management.—Prest., Wm. Vanderhurst. Supt., H. B. Jackson.

SAN BUENAVENTURA, *Ventura Co.* (Pop., 1,678; est., 3,500.) At mouth of San Buenaventura river, on Pacific ocean. A health resort. Settled in 1780; incorp. a village in '70.

History.—Built in '82 by Santa Ana Water Co., under a 50 years' franchise. Des. Engr., E. F. Hare. Town council fixes the rents from consumers yearly. In '88 an extension of the works was projected. Est. cost, $50,000.

Water Supply.—San Buenaventura river, by gravity to reservoirs, with pumping for a few houses on high ground.

Reservoirs.—Four, having a cap. of 80,000, 240,000, 500,000 and 900,000 galls., respectively. One impounds the river water, and is 150 by 200 ft., at 175 ft. above and 2½ miles from the town. A 10-in. riveted wrought-iron pipe leads to town.

Pumping Machinery.—A 360,000-gall. Worthington duplex pump, and a 20 H. P. boiler.

Distribution.—*Mains*, c. i., w. i., 11.8 miles. *Services*, galv. i. *Taps*, 512. *Meters*, none. *Hydrants*, kind not given, 12. *Valves*, Eddy.

Consumption, 1,190,000 galls. *Pressure*: Ordinary, 47 lbs. Fire 90 lbs.

Financial.—Cost, $137,879. Capital stock, $100,000. No bonds. Debt, $9,200. Int., 8%. Ann. op. exp., $5,582. Ann. rev.: consumers, $9,590; city, $60.

Management.—Prest., G. W. Chrisman. Supt. and Secy., E. P. Foster.

SAN DIEGO, *San Diego Co.* (Pop., 2,637; est., 25,000.) On San Diego bay surrounded by a hilly country. Founded in '30; incorp. in '50.

History.—Built in '73 by San Diego & Coronado Water Co. Des. Engr., H. M. Covert.

Water Supply.—San Diego river and well in or near Otay river, pumping to reservoir. The river has a drainage area of 40 sq. m. The well is 26 ft. in diam. by 18 ft. deep, lined with brick. Engr., W. R. Coats, Kalamazoo, Mich.

Pumping Machinery.—Dy. cap., 5,000 000 galls.; a 2,000,000-gall. Holly, and a 3,000,000-gall. Holly-Gaskill pump, the latter added in '88, and working against a head of 500 ft. Formerly a Hooker pump of 8-in. bore and 42-in. stroke lifted water 220 ft.

Reservoir.—Cap., 3,000,000 galls. In '82 there was 100,000-gall. reservoir, at 100 ft., and an 850,000-gall. reservoir at 200 ft. above the town.

Distribution.—*Mains*, riveted w. i., 28 miles. *Services*, w. i. *Taps*, 1,400. *Meters*, 245. *Hydrants*, kind not given, 69.

Consumption, 800,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 160 lbs.

Financial.—Cost, to '81, $79,000. Capital stock, $125,000 has been subscribed for, and a total of $500,000 authorized, Bonded debt, $250,000. Int., not given. Ann. op. exp., about $15,000. Ann. rev.: consumers, $52,867; city, $3,250. Hydrant rental, $50.

Management.—Prest., E. S. Babcock, Jr. V. Prest., H. L. Story. Treas., First National Bank, San Diego. Secy., Joseph A. Flint. No Supt.

SAN FRANCISCO, *San Francisco Co.* (Pop., 233,959; est., 250,000.) At the end of a peninsula 6 miles wide and 20 miles long, extending into San Francisco bay. In '81 its area was about 42 sq. m., including several islands, nearly half a high rocky hill, rising at points 800 ft. above the sea. Quite an extensive area of level land has been formed by grading, and by filling in the bay. Settled in '76 by the Spanish; in '35 a town called Yerba Buena was founded here, the name being changed to San Francisco in '47, when the population was 450. In '60 the population was 56,000.

History.—Built in '56-9; now owned by Spring Valley Water-Works Co. Supplies San Mateo.

In '57 the San Francisco Water-Works Co. was organized, with a capital stock of $1,500,000, which in '64 was increased to $2,000,000. In June, '58, the Spring Valley Water-Works Co. was organized, with a capital stock of $60,000, increased in '60 to $3,000,000. Each company built works, and operated them until '65, when the two were consolidated under the present name, with a capital stock of $6,000,000. In '68 the capital stock was increased to $8,000,000, and '76 to $16,000,000. The Engr. for the present company has been Hermann Schussler.

Water Supply.—Mountain streams, by gravity from impounding and storage, to distributing reservoirs, and Lobus creek and Lake Merced, by pumping to reservoirs.

Water is also pumped from lower Crystal Springs reservoir to Pilarcitos conduit. There are four storage and eight distributing reservoirs, and four main conduits leading to the city.

LOBUS CREEK PUMPING PLANT.

Mountain Lake.—On Lobus creek impounding flow from drainage area of 2¼ sq. m. The water is mainly from percolation through sand.

Conduit.—Partly of wood, and partly of masonry, extending 23,700 ft. to Black Point, at zero elevation, from which it is pumped.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; at first there were two condensing engines with 40-in. cylinder and 48-in. stroke, driving two pumps, one of 14-bore, 84-in. stroke, and 35,00,000 galls. cap., the other of 12-in. bore, 60-in. stroke, and 2,500,000 galls. cap. These pumps lifted water to the Lombard and Francisco street reservoirs, described below. Only the smaller of these pumps is now used here, the other [probably] having been removed to pump from the Crystal Springs conduit.

LAKE MERCED PUMPING PLANT.

Lake Merced.—Not described.

Pumping Machinery.—Dy. cap., 8,000,000 galls.

Conduit.—Connects with the conduit from San Andreas storage reservoir.

PILARCITOS CREEK SUPPLY.

Dam.—Of earth, 640 ft. long, 95 ft. high, 26 ft. wide on top, with slopes of 2¾ and 2½ to 1. A trench was dug below the bottom of the dam to solid rock, 26 ft., and filled with puddle. After the reservoir was filled a leak appeared, caused by unsound rock foundation. A shaft was sunk through the bank for 80 ft., the bad rock removed, and the space filled with puddle. This made the dam tight.

Reservoir.—Cap., 1,080,000,000 galls.; is 46 ft. deep, its water surface is at an elevation of 696 ft. The average yearly rainfall at this point is 49.7 in. The reservoir is on Pilarcitos creek, 15 miles from San Francisco, and was built in '64. The drainage area of the creek is 3¾ sq. m., and the drainage of an additional area of about 2 sq. m. is brought through a flume into the reservoir by intercepting the water of several streams, naturally emptying into the creek below the dam. *Flume*: About five miles long, with a cross section of 16 by 42 in.

Conduit.—Partly a wooden flume and partly a 30-in. wrought iron pipe, for 13 miles to Lake Honda, and thence by a 10-in. pipe to the Lombard street reservoir.

SAN ANDREAS SUPPLY.

Source.—Lock's and San Mateo creeks, and Pilarcitos creek below the Pilarcitos reservoir.

Gathering Conduits.—Water from Lock's creek is conveyed to the reservoir from an elevation of 505 ft. through a wooden flume, wrought iron pipe and masonry-lined tunnels, the distance being 17.42 miles. Water from San Mateo and Pilarcitos creeks is also brought to the reservoir through flumes and pipes.

Dam.—Of earth, 640 ft. long, 93 ft. high, and 25 ft. wide on top. A trench was dug below the botton of the dam, 47 ft., to rock, and filled with puddle.

Reservoir.—Cap., 7,000,000,000 galls.; 89 ft. deep, with water surface at elevation of 455 ft. Receives drainage from 10.81 sq. m. The average yearly rainfall at this point is 44.75 in.

Conduit.—Of 32 and 22 in. wrought-iron, 12.1 miles long, ending at College hill distributing reservoir.

CRYSTAL SPRINGS SUPPLY.

Dams.—Not described.

Upper Reservoir.—Cap., 8,630,143,000 galls ; has a depth of 75 ft., a surface elevation of 294 ft., and receives the drainage from an area of 15 sq. m.

Lower Reservoir.—Cap., 30,000,000,000 galls.; has a depth of 140 ft., a surface elevation of 305 ft., and a drainage area of 11½ sq. m. The average yearly rainfall at these reservoirs is 40 in.

Conduit.—Before the reservoir was completed the plan was for 21 miles of 40-in. iron pipe. It is not stated whether this plan was carried out.

Pumping Machinery.—Dy. cap., 3,500,000 galls. Lifts water from reservoir to Pilarcitos conduit.

CALAVERAS SUPPLY.

Source.—Calaveras creek, Arroyo Hondo and Arroyo Valle, having drainage area of 100, 40, and 110 sq. m., respectively, all gathered in Calaveras reservoir. The first two creeks discharge into the reservoir naturally, while an aqueduct about five miles long was constructed to bring in water from the latter.

Reservoir.—Cap., 30,351,000,000 galls.; has a depth of 183 ft., surface elevation of 745 ft., and receives drainage from 250 sq. m. The average yearly rainfall in this section is 40 in.

Conduit.—Length not given. Of 37-in. pipe, connecting with the Crystal Springs conduit a few miles from the city. It crosses the upper end of San Francisco bay by two 16-in. pipes.

DISTRIBUTING RESERVOIRS.

Lower Service.—Takes about one-half the supply.

Francisco Street Reservoir: Cap., 6,712,000 galls.; 14 ft. deep, and has a surface elevation of 139 ft. Filled by Pilarcitos conduit and Lobos creek pump.

Branvan Street Reservoir: Cap., 400,000 galls.; is 8 ft. deep, and has a surface elevation of 85 ft.

Middle Service.—Takes about one-sixth of the supply.

College Hill Reservoir.—Cap., 15,006,000 galls.; 15 ft. deep, and has a surface elevation of 253 sq. ft. Filled by San Andreas conduit.

Market Street Reservoir: Cap., 2,800,000 galls.; 15 ft. deep and has a surface, elevation of 196 ft.

Upper Service.—Takes about one-third of supply by the Pilarcitos conduit.

Lake Honda: Cap., 33,000,000 galls.; 29 ft. deep, and has a surface elevation of 377 ft. Filled by Pilarcitos conduit.

Lombard Street Reservoir: Cap., 3,724,000 galls.; is 22 ft. deep, and has a surface elevation of 306 ft. Filled from Pilarcitos conduit and Lobus creek pump.

Clay Street Reservoir or Tank; Cap., 141,000 galls.; circular, 9 ft. deep, and has a surface elevation of 375 ft.

University Mound: Cap., 35,000,000 galls. This is not classified in report, but probably belongs to high service.

The remaining data applies to the whole system:

General Summary.—The storage reservoirs have a combined cap. of about 67,061,143,000 galls., a combined drainage area of 288½ sq. m., and vary in elevation from 194 to 696 ft. The conduits, not including the Cavaleras supply, comprise about 30 miles of wrought iron pipe and about 23 miles of wooden flumes and masonry-lined tunnels. The wrought iron pipe follows the contour of the ground and its thickness is proportioned to the head, with a strain of 15,400 to 13,100 lbs. per sectional sq. in. The distributing reservoirs have a combined cap. of 61,232,000 galls., and vary in elevation from 85 to 377 ft. The pumping machinery has a combined dy. cap. of 14,000,000 galls.

Distribution.—*Mains*, c. i., w. i., 250 miles. *Services*, lead. *Taps*, 16,000. *Meters* 8,500. *Hydrants*, "all kinds," 1,480.

Consumption, 19,112,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $17,000,000. Debt, $5,000,000. Int., 5%. Ann. op. exp., about $800,000. Ann. rev.: total, $1.375,000; city, none in '86.

Management.—Prest., Chas. Webb Howard. Secy., Wm. Norris. Chf. Engr., Hermann Schussler. City Supt., Chas. Elliot.

SAN JOSE *Santa Clara Co.* (Pop., 12,567; est., 20,000.) On Los Gatos creek. Settled in '48; incorp. in '51.

History.—Built in '65 by San José Water Co. Const. Engr., Alex W. Hess. Contr., M. Chabot. The system includes the supply of Santa Clara.

Water Supply.—Mountain streams, by gravity from impounding to distributing reservoirs, and seven artesian wells, by pumping for about five months, to supplement gravity supply.

Impounding Reservoirs.—Cap., 150,000,000 galls. Three, the first two having areas of 22 and 12 acres, respectively.

Conduits.—Wooden flumes and concrete pipe, extending from impounding to distributing reservoirs, about 10 miles.

Distributing Reservoirs.—Cap., 8 000,000 galls.; three, the first one having a cap. of 2,000,000, at 70 ft. above town. Others, not described.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; Knowles compound pump.

Distribution.—*Mains*, c. i., riveted w. i., 65 miles. *Taps*, about 3,500. *Meters*, (in '84), 13. *Hydrants*, kind not given, 200.

Consumption, 3,000,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 40 lbs.

Financial.—Cost, $500,000. Capital stock, $700,000. Debt, $50,000. Int., 6%. Ann. op. exp., withheld, but est., $15,000. Ann. rev.: consumers, withheld, but est., $105,000; city, not given.

Management.—Prest., E. Williams. Supt., Wilbur Wilcox.

SAN LEANDRO, *Alameda Co.* (Pop., 1,369.) Supplied by Contra Costa Water Co., Oakland, which see.

SAN LUIS OBISPO, *San Luis Obispo Co.* (Pop., 2,243; est., 3,500.)

History.—Built in '74 by San Luis Water Co., under an exclusive franchise.

Water Supply.—San Luis creek, by gravity.

Impounding Reservoir.—Cap., 20,000,000 galls.

Distributing Reservoir.—Cap., 1,500,000 galls.; in excavation and embankment, 150 ft. above and two miles from town.

Distribution.—*Mains*, c. i., 9 miles. *Services*, not given. *Taps*, 250. *Meters*, none. *Hydrants*, San José, 22.

Consumption, 250,000 galls. *Pressure*: 150-ft. head.

Financial.—Cost, $75,000. Capital stock and bonds, $60,000. Ann. op. exp., withheld, but est., $2,000. Ann. rev.: consumers, withheld, but est., $10,000. Hydrants free.

Management.—Prest., J. P. Andrews. Secy., M. Egan.

SAN MATEO, *San Mateo Co.* (Pop., 932.)

General Description.—Supplied by gravity from Spring Valley Water Co., of San Francisco. Address Chf. Engr., Hermann Schussler, San Francisco, or W. H. Lawrence, San Mateo. No other information given.

SAN PEDRO, *Los Angeles Co.* See Wilmington and San Pedro.

SAN RAFAEL, *Marin Co.* (Pop., 2,276; est., 3,000.) On San Pablo straits.

History.—Built in '71 by Marin County Water Co.

Water Supply.—A mountain lake, with an area of 22 acres, by gravity.

Conduit.—Of wood, 16 by 12 in., and 1,500 ft. long. Built to connect with first reservoir.

Reservoirs.—Cap., 3,000,000 and 8,000,000 galls., respectively. The first is 150 ft. above town.

Distribution.—*Mains*, c. i., w. i., 15 miles. *Services*, w. i. *Taps*, 580. *Meters*, 24. *Hydrants*, kind not given, 36. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, $600,000. Capital stock, $600,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $2,500. Ann. rev.: consumers, $34,000; city, $900. No hydrant rental.

Management.—Prest. and Supt., R. Walker. Secy., H. R. Catton.

SANTA ANA, *Los Angeles Co.* (Pop., 3,024; est., 6,000.)

History.—Built in '88 9 by city. Engr. and Contr., W. R. Coats, Kalamazoo, Mich.

Water Supply.—Artesian wells, pumping to tank and direct.

Pumping Machinery.—Cap., 1,500,000 galls. One duplex compound Holly-Gaskill pump.

Tank.—Cap., 250,000 galls.; placed on 100-ft. elevation.

Distribution.—*Mains*, 8 and 6-in. c. i., 7 miles. Contrs., Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Services*, *Taps* and *Meters*, not given. *Hydrants*, Gaskill, 33.

Pressure: Ordinary, 50 lbs. Fire, 50 to 90 lbs.

Financial.—Cost, $50,000. Bonded debt, $50,000. Int., 6%. Ann. op. exp. and revenues, not given.

Management.—Not given.

SANTA BARBARA, *Santa Barbara Co.* (Pop., 3,610; est., 8,000.) At southeast end of a valley two miles wide and five miles long. Missouri creek passes through the city, but it is dry except in the rainy season. Settled about 1780; incorp. a city in '74.

MISSION WATER CO.'S WORKS.

History.—Built in '30 by Franciscan monks, and extended by the present company in '73, they having bought the works, date not given, for $20,000. Des. Engr for extensions, Hermann Schussler, San Francisco. Const. Engrs., R. B. & A. W. Canfield, Santa Barbara.

Water Supply.—Mission creek, by gravity.

Impounding Dam.—Stone in cement, 100 ft. long, 16 ft. high and 16 ft. thick.

Conduit.—From dam to reservoir, 10,000 ft. Originally this was an open ditch, lined with stone in cement. In '73 a V-shaped wooden flume was substituted, with sides 12-in. wide, laid on a grade of 2½ ft. per 100.

Reservoir.—Cap., about 90,000 galls.; 110 ft. sq. by 10 ft. deep. The walls are of stone in cement, vertical on the inner face, 15 ft. thick, for 4 ft. from the bottom, and 3 ft. thick at top. The water surface is 300 ft. above city.

Distribution.—*Mains*, c. i., riveted and welded w. i., 11 miles. *Services*, galv. i. *Taps*, 660. *Meters*, none. *Hydrants*, kind not given, 18.

Consumption, 275,000 galls. *Pressure*: Ordinary, 60 lbs.

Financial.—Cost, withheld. but est., $100,000. Capital stock, $120,000. Bonds, none. Ann. op. exp., $6,300. Ann. rev.: consumers, $14,500; city, not given.

To Dec., '81, the works had cost $50,586, and the gross receipts had been $55,548.

Management.—Prest., R. B. Canfield. Supt. and Secy., A. W. Canfield.

DE LA GUERRA GARDEN SPRINGS WATER CO.'S WORKS.

History.—Built in '88. Engr., W. R. Coats, Kalamazoo, Mich.

Water Supply.—Surface well, by direct pumping, the surplus going to ahigh and a low service tank. The well is 30 ft. in diam., about 36 ft., deep, and yields about 1,000,000 galls. a day. It was sunk through from 17 to 26 ft. of muck, and 15 to 6 ft. of hardpan and blue clay to a gravel stratum 2½ ft. thick.

Pumping Machinery.—Not described.

Tanks.—Two, of steel, enclosed, size not given.

Distribution.—*Mains*, 16 to 6-in. c. i., 20 miles. *Hydrants*, 200.

Financial.—Cost, est., $250,000.

Management.—Prest., Wm. Barnhart.

NOTE:—At time of latest report only the well had been completed, and the remainder of the description is in accordance with the plans as they then stood.

SANTA CLARA, *Santa Clara Co.* (Pop., 2,416; est., 3,000.) A part of the San José Water Co.'s works, which see.

SANTA CRUZ, *Santa Cruz Co.* (Pop., 3,898; est., 6,500.) On San Lorenzo river and Monterey bay. The business part of the city on flat ground, and the residence section on an elevated plateau. Manufactures lumber, leather, powder, paper and lime. A summer resort. Settled in 1719; incorp. a city in '56.

History.—Built in '76 by Santa Cruz Water Co. Engr., Edgar M. Morgan, deceased.

Water Supply.—Branciforte and Major's creeks, by gravity to reservoirs. The first creek is east and the second west of the city, and there is a distributing reservoir for each.

Reservoirs.—Combined cap., 650,000 galls.; 100 ft. above city, excavated in chalk rock, and lined with 3-ft. rubble masonry walls.

Distribution.—*Mains*, riveted w. i., 25 miles; wooden pipe was first used, but was not satisfactory. *Services*, w. i. *Taps*, 700. *Meters*, none. *Hydrants*, Garrett, 50. *Valves*, Eddy.

Consumption, 400,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $175,000. Capital stock, $100,000. Bonded debt, $50,000. Int., 8%. Ann. op. exp., $2,500. Ann. rev.: consumers, $12,000; city, $900, for street sprinkling. Hydrants free.

Management.—Prest., F. E. Fagan. Secy., H. E. Cox. Supt. and Treas., W. H. Duke.

SANTA ROSA, *Sonoma Co.* (Pop., 3,616; est., 7,000.) On Santa Rosa creek in a valley 10 miles wide, between high mountains. Settled in '52; incorp. a city in '67.

History.—Built in '73 by Santa Rosa Water Co., under 50 years' franchise. Engr., Preston Davis.

Water Supply.—Santa Rosa and Alamos creeks, by gravity.

Dam.—Built across mouth of a canyon to form reservoir; of concrete, 100 ft. long and 8 ft. thick, height not given.

Reservoir.—Cap., about 150,000,000 galls.; covers 26 acres, is 24 ft. deep, and is 80 ft. above, and two miles from city.

Supply Main.—Of 15-in, riveted w. i., leading two miles to city.

Distribution.—*Mains*, w. i., 15 miles. *Services*, w. i. *Taps*, (in '86) 800. *Meters* and *Hydrants*, none.

Consumption, not given. *Pressure*: Ordinary, 28 lbs. Fire, 56 lbs.

Financial.—Cost, about $150,000, Capital stock, $50,000. No bonds. Debt, about

$3,000. Int., 6%. Ann. op. exp., in '86, $4,402. Ann. rev.: consumers, in '86, $12,424; city, none.

Management.—Prest. and Supt., Mark L. M. Donald. Secy., T. A. Proctor.

SONORA, *Tuolumne Co.* (Pop., 1,492; est., 2,000.) On Woods creek.

History.—Built in '53 by Gold Mount Water Co. Const. Engr., W. S. Cooper.

Water Supply.—Springs, by gravity to reservoir, thence repumped to another reservoir.

Pumping Machinery.—Dy. cap., not given; an 8-in. double-acting water-power pump of 20-in. stroke.

Reservoir.—Cap., 150,000 and 120,000 galls., respectively.

Distribution.—*Mains*, 4 and 3-in. c. i., 3 miles. *Services*, not given. *Taps*, 230. *Meters*, not given. *Hydrants*, kind not given. 25.

Consumption, 400,000 galls. *Pressure*: 150 ft. head.

Financial.—Cost, $25,000. Capital stock, $25,000. Debt, $3,000. Int., 6%. Ann. op. exp., $2,000. Ann. rev.; consumers, $3,800; city, $200.

Management.—Prest., Mrs. Julia Clark. Secy., Mrs. Jno. Ferguson. Supt., Jno Ferguson.

SPRING VALLEY, *Washington Co.* (Pop., 1,685.)

History.—Built in '84-5 by Thomas Hague. Engr., F. H. Reed.

Water Supply.—Mokelumne river, by gravity to reservoir, through a ditch 4 miles long.

Reservoir.—Cap. 120,000 galls.

Distribution.—*Mains*, 3 and 4 in., ½ mile. *Taps*, 25.

Financial.—Cost, $3,500. No debt.

Management.—Owner, Thomas Hague, 2,228 Front St., San Francisco. Supt., H. A. Mensinger.

NOTE:—In '88 the owner proposed bringing water from springs 1¾ miles from town. No further information given.

STOCKTON, *San Joaquin Co.* (Pop., 10,282; est., 16,000.) On level ground three miles from San Joaquin river, with which it is connected by a navigable channel. Settled in '48; incorp. a city in '50.

History.—Owned by Stockton Water-Works Co. In '57 P. E. Connor built works, which are now owned by above company, their franchise running for 20 years. In '84 the works were extended.

Water Supply.—Artesian wells, pumping to reservoir, stand-pipe and tanks. Three of the wells are 145, 200 and 1,000 ft. deep, respectively.

Pumping Machinery.—Dy. cap., 4,500,000 galls.; a 1,500,000-gall. Risdon and a 3,000,000 gall. Worthington pump. [In '83 Blake, Cameron and Hooker pumps, one each, were in use. These may have been for pumping from wells to reservoir, and may still be in use, though not described in report for '88.]

Reservoir.—Of earth, no further description given.

Stand-Pipe.—Of plate-iron, 3 ft. in diam. by 75 ft. high.

Tanks.—Of wood, size not given. In '83 an iron tank was reported as in use, 22 by 44 ft., by 8 ft. deep, at 50 ft. above city.

Distribution.—*Mains*, c. i., 8 miles. *Services*, w. i. *Taps*, 650. *Meters* and *Hydrants*, none.

Consumption, 1,000,000 galls. *Pressure*: Ordinary, 34 lbs.

Financial.—Cost, withheld, but est., $100,000. Capital stock, in '83, $100,000. No further figures given, but est.:—Ann. op., $5,000. Ann. rev.; consumers, $19,500.

Management.—Supt., M. S. Thresher.

SUTTER CREEK *Amador Co.* (Pop., 1,324.)

General Description.—Owned by Blue Lakes Water Co. Gravity system with one reservoir and 20 hydrants. No other information can be obtained.

NOTE:—The works at Jackson take their supply from the company's canal which is probably for irrigating purposes.

TEMPLETON, *San Luis Obispo Co.* (Pop., est., 600.)

History.—Built in '87 by Templeton Water Co. Engr., R. M. Shackelford.

Water Supply.—Well, pumping to reservoir.

Pumping Machinery.—Dow pump; cap., not given.

Reservoir.—Cap., 35,000 galls.

Distribution.—*Mains*, 4 in. galv. i., 1 miles. *Services*, ¾ and ½ in. *Taps*, 50. *Meters*, not given. *Hydrants*, kind not given, 6.

Consumption, 9,000 galls. *Pressure*: 45 lbs.

Financial.—Capital stock, $5,000. Ann. rev.: consumers, $900.

Management.—Manager and Supt., R. M. Shackelford. Collector, C. M. Steinbeck.

THERMALITO COLONY, *Oroville, Butte Co.* (Pop., est., 3,000.)

History.—Built in '87-8 by Thermalito Colony Co., principally for irrigating purposes. Const. Engr., Thomas Kelley.

Water Supply.—West branch of Feather river, by gravity to reservoirs.

Reservoirs.—Cap. 20,000,000 galls.

Distribution.—*Mains*, 30 to 8-in., 9 miles, from Brock & Taber. *Services*, 397. *Meters*, none. *Hydrants*, kind not given, 40.

Consumption, 4,000,000 galls. in summer; 1,000,000 galls. in winter. *Pressure*: 160-ft. head.

Financial.—Cost, $250,000. Capital stock, $1,000,000. Debt, $75,000. Int., 7%. Ann. op. exp., $2,500. Ann. rev.: not given.

Management.—Prest. and Supt., A. F. Jones. V. Prest., F. McLaughlin. Secy., H. C. Hill. Treas., E. W. Fogg.

NOTE:—Report also states that the water used by Oroville Water Co. is supplied by this company.

TRUCKEE, *Nevada Co.* (Pop., 1,147; est., 2,000.) On Truckee river.

History.—Built in '68, and now owned by Geo. Scheafer.

Water Supply.—Springs, by gravity.

Tank.—Cap., 337,500 galls.; 50 by 150 ft., by 6 ft. deep.

Distribution.—*Mains*, 11 and 7-in., 1½ miles. *Hydrants*, 8.

Pressure: 90-ft. head.

Financial.—Cost, about $4,000. No debt. Ann. op. exp., withheld, but est., $500. Ann. rev.: consumers, $2,000; city, none. Hydrants free.

Management.—Owner, Geo. Scheafer, assisted by F. P. Stevens.

TULARE, *Tulare Co.* (Pop., of township, 802; est., 2,500.)

History.—Built in '82 by Tulare City Water Co., under a 50 years' franchise. Des. Engr., T. J. Flannigan. Const. Engr., D. N. Madden, Tulare.

Water Supply.—Two artesian wells, 400 ft. deep, pumping direct and to tanks.

Pumping Machinery.—Dy. cap., 150,000 galls.; two 75,000-gall. Hooker pumps.

Tank.—Of wood, cap., 100,000 galls.

Distribution.—*Mains*, iron, 11 miles. *Services*, brass. *Taps*, 400. *Meters*, 1. *Hydrants*, not given.

Consumption, 38,400 galls. *Pressure*: Ordinary, 37 lbs. Fire, 60 lbs.

Financial.—Cost, $60,000. Capital stock, $100,000. No bonds or debt. Ann. op. exp., $4,680. Ann. rev.: total, $9,600.

Management.—Supt., D. N. Madden.

VALLEJO, *Solano Co.* (Pop., 5,987; est., 5,000.) On straits of Carquinas on San Pablo bay, in rolling country. Settled in '52.

History.—Built in '69-70 by Vallejo Water Co. Des. Engr., Hermann Schussler, San Francisco. Labor done by company.

Water Supply.—Artificial lake, by gravity, and by pumping from supply mains to reservoir and stand-pipe. The lake has area of 160 acres, a drainage area of 10 sq. m., and is three miles northeast of the city.

Dam.—Forms lake; of earth, 300 ft. long and 40 ft. high. The original plan was for a dam 70 ft. high.

Supply Main.—Of 12-in. c. i., about three miles long.

Pumping Machinery.—Dy. cap., 5,000,000 galls.; two 2,500,000-gall. Hooker pumps.

Reservoir.—Cap., 500,000 galls.; in excavation, 150 ft. above tide level.

Stand-Pipe.—Of wrought-iron, size not given.

Distribution.—*Mains*, c. i., 18 miles; w. i. was first used, but it lasted only from 6 to 8 years. *Services*, w. i. *Taps*, 1,000. *Meters*, 25. *Hydrants*, kind not given, 40.

Consumption, 250,000 galls. *Pressure*: from 0 to 75 lbs.

Financial.—Cost, $250,000. Bonded debt, $200,000. Int., 5%. Ann. op. exp., withheld, but est., $12,000. Ann. rev.: consumers, withheld, but est., $35,000; city, none. Hydrants free.

Management.—Secy., G. W. Wilson. Supt., A. J. McPike.

VISALIA, *Tulare Co.* (Pop., 1,412; est., 3,500.) On Kaweah river, 18 miles northeast of Tulare lake. Engaged in mining.

History.—Built in '77 by W. H. Hammond, under a 20 years' franchise. Des. Engr., D. B. Jones. Const. Engr., J. M. Fox. Sub-Contrs., Fox & Wilde. All of Visalia.

Water Supply.—Artesian wells, pumping to tanks and direct.

Pumping Machinery.—Combined cap., 840,000 galls. One 360,000-gall Blake, and two 240.000-gall. Hooker pumps from H. P. Gregory, San Francisco.

Tanks.—Cap., 38,000; 20,000 and 18,000 galls. respectively; from Fox & Wilde. A 40,000-gall. tank was to be added in '88.

Distribution.—*Mains*, material not given, 5 miles; from Dunham, Carrigan & Co., San Francisco. *Services*, 2 in. w. i. *Taps*, not given. *Meters*, none. *Hydrants*, from Dunham, Carrigan & Co., 12.

Consumption, 200,000 galls. *Pressure*: not given.

Financial.—Cost, $30,000. Debt, $10,000 Int., 7%. Ann. op. exp., $3,120. Ann. rev.: consumers, $6.270; city, $450.

Management.—Owner, W. H. Hammond. Supt., C. E. Bliss.

WATSONVILLE, *Santa Cruz Co.* (Pop., 1,799; est., 3,000.) On level ground, on Pajaro river. Settled in '52; incorp. a town in '68.

History.—Built in '76-8 by Corralitos Water Co. Engr., J. B. Culver. Labor done by company.

Water Supply.—Corralitos creek, 7 miles distant, by gravity to reservoir.

Conduit.—Of redwood, 12 by 15 in., extending 5 miles to reservoirs.

Reservoirs.—Cap., 2,000,000 and 800,000 galls., respectively. The first is in excavation in hard clay, 125 by 175 ft., 90 ft., above and two miles from town.

Supply Main.—In '83 an 8-in. riveted wrought iron pipe led from first reservoir to town, 2 miles.

Distribution.—*Mains*, riveted w. i., 8 miles. *Services*, w. i. *Taps*, 450. *Meters*, none. *Hydrants*, kind not given, 22.

Consumption, not given. *Pressure*: 35 lbs.

Financial.—Cost, $120.000. Capital stock, $100,000. No bonds or debt. Ann. op. exp., $[illegible],000. Ann. rev.: consumers, $7,500; city, $600 for street sprinkling and hydrants.

Management.—Supt., A. White. Most, or all, of the stock is owned by Francis Smith & W. W. Montague, 130 Beale St., San Francisco. The main offices of the company are at this address.

WEST BERKELEY, *Alameda Co.* (Pop., 2,000; est., 4,000.)

History.—Built *about* '75; now owned by Alameda Water Co. No Engr. employed.

Water Supply.—Tunnels driven into hills, and springs by gravity.

Reservoirs.—Cap., 3,000,000 and about 8,000,000 galls., respectively.

Distribution.—*Mains*, black w. i. *Services*, do., and galv. i. *Taps*, 500 or 600. *Hydrants*, 30.

Management.—Prest., Moses Hopkins. Supt., C. A. Grow. Asst. Supt., L. Wellendorff.

NOTE:—Further information cannot be obtained. The above was given by W. G Raymond, Berkeley.

WILMINGTON and SAN PEDRO, *Los Angeles Co.* (Pop.: Wilmington township, 1,865; est., 1,100. San Pedro: est., 1,500.)

History.—Built in '82 by Wilmington Development Co., under a 50 years' franchise. Contr. for masonry, Cyrus Willard, Los Angeles.

Water Supply.—Wells, pumping to tanks and direct.

Pumping Machinery.—Dy. cap., 800,000 galls.; a Blake and a compound duplex pump

Tanks.—Three, cap., 50.000 galls. each.

Distribution.—*Mains* w. i., 12 miles; from Mellert Foundry & Machine Co., Reading, Pa. *Services*, w. i. *Taps*, 408. *Meters*, Worthington, and Hersey, 3. *Hydrants* and *Valves*, Eddy.

Consumption, 300,000 galls. *Pressure*: 50 to 120 lbs.

Financial.—Cost, $50,000. No further data given.

Management.—Prest., J. B. Banning. Engr., A. Young.

WOODLAND, *Yolo Co.* (Pop., 2,257; est., 4,500.)

History.—First supplied in '73 by a company. These works were rebuilt, or a second company organized, in '81. The following is a description of the Woodland Water Co's works, built in '85, with S. Shryock as Const. Engr.

Water Supply.—Four 200-ft. artesian wells, pumping direct and to tanks.

Pumping Machinery.—Dy. cap.,1,000,000 galls.; two pumps,Hooker and Thompson & Evans.

Tanks.—Four, with a combined cap. of 100,000 galls.

Distribution.—*Mains*, w. i., length not given. *Services*, black i. *Taps*, 800. *Meters*, one. *Hydrants*, Jackson, number not given.

Consumption, 500,000 galls. *Pressure*: about 25 lbs.

Financial.—Cost and debt not given. Capital stock, $50,000. Ann. op. exp.,withheld, but est., $5,000. Ann. rev.: consumers, withheld, but est., $20,000; city, not given. Hydrant rental, $12.

Management.—Supt., L. G. Rhodes.

YREKA, *Siskiyou Co.* (Pop., 1,059.) On Yreka creek. Settled in '51; incorp. a village in '55.

History.—Built in '62 by H. Scheld.

Water Supply.—Springs, by gravity. The water is collected in a wooden conduit 8 in. sq., with a fall of 1 in 200.

Tank.—Cap., 60,000 galls.; of wood, from 22 to 50 ft. above, and ½ mile from town, with which it is connected by bored pine logs 6 in. in diam.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, black i. *Taps*, about 90. *Meters*, none. *Hydrants*, none, but there are 12 fire cisterns.

Consumption, 60,000 galls. *Pressure*: light.

Financial.—Cost, $12,000. Ann. op. exp., $600. Ann. rev.: consumers, $3,600; city, $300.

Management.—Owner, Henry Scheld.

Water-Works Projected with Fair Prospects of Construction.

COLTON *San Bernardino Co.* (Pop., est., 2,000.) In mining district.

Proposed System.—It was unofficially reported in '88 that the city voted bonds for water-works.

Address City Engr., H. P. Bailey, or W. W. Wilcox.

FOLSOM CITY, *Sacramento Co.* (Pop., est., 2,500.) On American river. In mining district.

Proposed System.—In '88 the National Mining Co. proposed erecting works. It was unofficially reported that a canal 6 ft. deep and 32 ft. wide was to be built by convict labor, to convey water from the American river for water supply and water-power; also that the National Water Co. proposed establishing works.

SAN BERNARDINO, *San Bernardino Co.* (Pop., 1,673; est., 10,000.) Is five miles from Santa Ana river. Engaged in mining.

Proposed System.—In '88 the city proposed issuing bonds and establishing a gravity system, at an est. cost of $100,000. Supply to be taken from canyons, nine miles from city, and piped to a reservoir and stand-pipe. Address City Engr., A. H. Koebig, F. T. Perris or A. H. Koelz.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Dixon, *Solano Co.*; Lemoore, *Tulare Co.*; Scenega, *Ventura Co.*; Wheatland, *Yuba Co.*

ARIZONA.

Water-Works Completed or in Process of Construction.

PHOENIX, *Maricopa Co.* (Pop., est., 5,000.) On Salt river. Engaged in mining.

History.—Built in '87-8 by J. J. Gardiner & Son, under a 50 years' franchise Const. Engr., W. F. Hutchinson.

Water Supply.—Wells, pumping to stand-pipe and tank.

Pumping Machinery.—Dy. cap., 25,000 galls. One Blake pump and one 40 H. P. boiler.

Stand-Pipe.—Is 150 ft. high.

Tank.—Cap., 20,000 galls.: 60 ft. high, on 3 brick columns.

Distribution.—*Mains*, 5 miles. *Taps*, 300. *Meters*, none. *Hydrants*, kind not given, 18.

Consumption, 50,000 galls. *Pressure*: Ordinary, 80 lbs. Fire, 150 lbs.

Financial.—Cost, $25,000. Capital stock, about $20,000. Debt, $5,000. Int., 12%. Ann. op. exp., and rev., not given.

Management.—Prest., J. J. Gardiner. Secy. and Supt., J. M. Gardiner.

PRESCOTT, *Yavapai Co.* (Pop., 1,836; est., 4,500.)

History.—Built in '84 by town. Const. Engr. and Contr., Geo. B. Inman, New York City.

Water Supply.—Creek, pumping to reservoir.

Dam.—Founded on bed rock, in creek, size not given.

Filter.—Of brick.

Reservoir.—Cap., about 5,000,000 galls.; 150 by 200 ft., by 25 ft. deep, and 185 ft. above town.

Distribution.—*Mains*, 8 to 4-in. w. i., 3 miles. *Services*, w. i. *Taps*, 255. *Meters*, 45. *Hydrants*, kind not given, 25. *Valves*, Ludlow.

Consumption, 60,000 galls. *Pressure*: Ordinary, 100 lbs. Fire, 130 lbs.

Financial.—Cost, $60,000. Bonded debt, $60,000. Int., 8%. Ann. op. exp., about $5,000. Ann. rev.: consumers, not given, but est., $7.500.

Management.—City Council. Engr., J. F. Mahoney.

TOMBSTONE, *Cochise Co.* (Pop., 973; est., 6,000.) A mining town. Settled about '78.

History.—Built in '81-2 by Huachuco Water Co. An earlier supply was introduced by a company, date not given. Water was brought from Sycamore springs, 8 miles distant, through wrought-iron pipe to two small tanks, 50 ft. above the town. Later the Tombstone Water, Mill & Land Co. brought water from a stream 2½ miles distant to a 110,000-gall. reservoir on Comstock hill, near the town. It is not stated whether either of these companies are now in existence.

Water Supply.—Collecting reservoir at head of Miller's canyon, 25 miles south of city, by gravity to distributing reservoir.

Collecting Reservoir.—Is 100 by 80 ft., by 22 ft. deep, at 1,000 ft. above city.

Conduit.—Of 7-in. lap-welded wrought-iron, 25 miles long. It passes down the canyon, across San Pedro valley, 1,900 ft. lower than the source, then up to the distributing reservoir. The supply carried by the conduit is increased by water from a spring in a lateral canyon, introduced through a 3-in. pipe, under 1,800-ft. head, and also from Carr's canyon, through a 5-in. pipe, 4 miles long.

Distributing Reservoir.—Cap., about 1,000,000 galls.; 80 by 90 ft., by 20 ft. deep, excavated in rock, lined with stone masonry, having its bottom covered with Portland cement concrete. It is 365 ft. above principal street of city. Two 7-in. pipes lead to city.

Distribution.—Not given.

Financial.—Cost, to '82, $500,000.

Management.—Not given. Address J. W. Clark.

NOTE:—No report given since '82.

TUCSON, *Pima Co.* (Pop., 7,007; est., 8,500.) On Santa Cruz river. Engaged in mining and in reduction of ores.

History.—Built in '81 by Tucson Water Co., under 25 years' franchise. Engr., Jno. P. Culver.

Water Supply.—Santa Cruz river, by gravity.

Conduit.—Unofficially reported as 5 miles long, and of 12-in. pipe.

Distribution.—*Mains*, kind not given, 6 miles. *Services*, not given. *Taps*, 500. *Meters*, 13. *Hydrants*, kind not given, 60.

Consumption, 160,000 galls. *Pressure*: Ordinary, 38 lbs. Fire, 52 lbs.

Financial.—Cost, $80,000. Capital stock and bonds, $150,000. Int., 8%. Ann. op., exp., $4,000. Ann. rev.: consumers, $15,500; city, $2,500. Hydrant rental, $50 each.

Management.—Supt., R. N. Leatherwood. Other officers: A. Granby, J. B. Watts. Report by D. J. Baleyn, Chf. City Fire Dept.

NEVADA.

Water-Works Completed or in Process of Construction.

AUSTIN, *Lander Co.* (Pop., 1,679; est., 1,500.) Engaged in mining.

History.—Built in '65 by Austin City Water Co., under a 15 years' franchise, which has been renewed for 15 years more.

Water Supply.—Tunnel driven into mountain, by gravity from reservoir.

Reservoir.—Cap., 50,000 galls.; brick, 500 ft. above city.

Distribution.—*Mains*, riveted galv. i., w. i., 1½ miles. *Services*, w. i. *Taps*, 200. *Meters*, none. *Hydrants*, from Hinckley & Co., San Francisco, 17.

Consumption, 30,000 galls. *Pressure*: 97 lbs.

Financial.—Cost, $20,000. No stock, bonds or debt. Ann. op. exp., about $2,400. Ann. rev.: consumers, withheld, but est., $6,000; city, not given. Hydrants free.

Management.—Prest., W. W. Bisbot. Secy., R. W. Heath. Agt., W. Foster. No Supt.

CANDALARIA, *Esmeralda Co.* (Pop., 756.)

History.—Built in '82 by Candelaria Water Works & Milling Co., Ltd., of London. Des. Engr., W. J. Sutherland. Const. Engr., Nelson Westcott, the present Supt. Labor done by company.

Water Supply.—Springs in White Mts., about 30 miles distant, by gravity.

Reservoir.—Cap., 500,000 galls.

Distribution.—*Mains*, 5 and 4 in., w. i., 30 miles, most of which is supply conduit. *Services* and *Taps*, not given. *Meters*, none. *Hydrants*, 4.

Consumption, 100,000 galls. *Pressure*: from 300 to 1,000-ft. head.

Financial.—Cost, $250,000. Bonded debt, $250,000. Int., 3%. Ann. op. exp., $10-900. Ann. rev.: consumers, not given, but est., $50,000.

Management.—Supt., Nelson Westcott.

CARSON CITY, *Armsby Co.* (Pop., 4,229; est., 4,000.) Is 4 miles from Carson river.

General Description.—Owned by company. Gravity system. *Hydrants*, 32. Ann op. exp., $1,600. Supt., Alfred Helm. A full report has never been received.

ELKO, *Elko Co.* (Pop., 752.) On Humboldt river.

History.—Built in '72-4 by Hi Lay Co. Engr., Robt. Cullen.

Water Supply.—Humboldt river, by gravity.

Reservoir.—Cap., 4,600 galls.

Distribution.—*Mains*, 3,500 ft.

Pressure: 75 ft. head.

Financial.—Cost, $2,740. No debt.

Management.—Supt., Hi Lay. Report by T. N. Stone.

EUREKA, *Eureka Co.* (Pop., 4,207; est., 2,000.) Engaged in mining, smelting and reducing silver ore. Settled in '64.

History.—Built in '71 by W. W. McCoy, and now owned by Mrs. May J. McCoy.

Water Supply.—Springs, collected in tanks, by gravity.

Tanks.—Six, combined cap., 250,000 galls.

Distribution.—*Mains*, w. i., 20 miles. *Services*, w. i. *Taps*, 900. *Meters*, none. *Hydrants*, kind not given, 20.

Consumption, 200,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, to '82, $60,000. No stock, bonds or debt. No further figures given.

Management.—Supt. Geo., F. Bliss.

GOLD HILL, *Storey Co.* See Virginia City.

HAMILTON, *White Pine Co.* (Pop., 203; est., not given.) Is 8,500 ft. above city Settled in '67; incorp. a city in '69, and disincorp. in '75. This was once an active mining town, but has been nearly abandoned.

History.—Built in '69 by Eberhardt Mining Co. Des. Engr., H. W. Von. Schmidt. The water is now used principally for mining purposes.

Water Supply.—Illapoh springs, pumping to reservoir. There are three pumping stations; the first pumps lifting water 500 ft., in a mile, the second 500 ft. more to a reservoir, from which it flows two miles across a deep valley and up Treasure Mt. to the reservoir level, where it is again repumped, this time through 1¼ miles of pipe, up the mountain to Treasure city, a further height of 700 ft.

Pumping Machinery.—Cap. not given. There are two Cameron pumps, at each of the first two stations, with 22¼ steam, and 10-in. water cylinders, of 60-in. stroke. The pumps at the third station are not described.

Force Mains.—Of 12-in. riveted wrought iron, with cast-iron hub joints, leaded The pipe is ¼-in. thick for the first 250-ft. rise, and ⅜-in. for the last, between each station. It frequently bursts. The normal working pressure at each station is 217 lbs., but by irregular action it sometimes reaches 250 lbs. To relieve the pipe compressed air is forced into four chambers on the line. The third force main is 1¼ miles long, size not given.

Reservoir.—Cap., 200,000 galls.; of stone, 500 ft. above Hamilton.

Distribution.—(In '81.) *Mains*, 14 miles; No. 11 gauge 3-in. lap-welded w. i., with c. i. sleeve couplings and lead joints. This pipe was too light, not well coated with asphalt and rusted through in wet ground. *Services*, w. i. *Taps*, 125. *Meters*, 20. *Hydrants*, 20.

Consumption, 10,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 200 lbs.

Financial.—Cost to '81, $380,000.

Management.—Not given. Address T. Hagar.

NOTE:—The last report from these works was in '81, and the above describes the works as they had been, previously.

PIOCHE, *Lincoln Co.* (Pop., 745.) Mining town, about 7,000 ft. above the sea. Settled in '69.

History.—Built in '72 by individuals, formerly known as Floral Springs Water Co. With the decline of the town the works from '78 to '83 did not pay the salary of the Supt., R. H. Elam, and other expenses, and in '83 the works came into the hands of Mr. Elam. In '88 Mr. Elam died, and the works were sold by the heirs to W. Godbe & Co., but the Administrator, Jas. McFadden, not having been consulted, refused to deliver the works. The matter had not been settled at last reports. The works were designed by Geo. Coffee.

Water Supply.—Two springs, by gravity to tanks. The Springs have a dy. yield of about 50,000 galls. are about 5½ miles from and 500 ft. above the town, the pipe line passing over very irregular ground, descending nearly 300 ft. below the town

Tanks.—Two, cap., 100,000 each; of wood, one 300, and the other about 200 ft. above town.

Distribution.—*Mains*, 8 to 5 in. iron, 7 miles. *Services* w. i. *Taps*, not given. *Meters*, none. *Hydrants*, Garrett, about 12.

Consumption, not given. *Pressure*: 300-ft. head.

Financial.—Cost, about $150,000. Ann. op. exp., $2,000. Ann. rev. consumers, about $3,500; city, $2,000. Hydrant rental, not given.

Management.—Address Jas. McFadden. Report by Frank Godbe.

RENO, *Washoe Co.* (Pop., 1,302; est., 3,000.) On Truckee river, which furnishes water-power. Settled in '69; incorp. a town in '79.

History—Built in '73 by A. A. Evans.

Water Supply.—Truckee river, by gravity through ditch 14 miles long to reservoir.

Reservoir.—In embankment, 180 ft. above town.

Distribution.—*Mains*, 15 to 2 in. riveted w. i., 8 miles. *Services*, iron. *Taps*, not given. *Meters*, none. *Hydrants*, 10.

Consumption, unknown. *Pressure*: 90 lbs.

Financial.—Not given.

Management.—Not given.

NOTE:—No report given since '84.

SILVER CITY, *Lyon Co.* See Virginia City.

TUSCARORA, *Elko Co.* (Pop., est., 2,500.) Engaged in silver mining.

General Description.—In '88 the Tuscarora Water Co. were building works.

taking supply from Twin Bridges creek. Cost, est., $150,000. Prest., P. C. Hyman. Supt., H. W. Coffin. Engr., Herman Schussler, San Francisco.

NOTE:—No further information can be obtained.

VIRGINIA CITY, GOLD HILL and SILVER CITY, *Storey Co.* (Pop.: Virginia City, 10,917; est., 8,000. Gold Hill, 4,531. Silver City, 605.) These towns are on the east side of Mt. Davidson, and have mining industries. Virginia City is 6,200 ft. above the sea. Gold Hill is on Gold run, a dry ravine two miles from Virginia City, and 200 ft. lower, and Silver City is two miles further down the ravine. Virginia City was settled in '59.

History.—Built in '72 by company. Des. Engr., Hermann Schussler, San Francisco. Later work has been in charge of the Supt., J. B. Overton. All labor done by company. Before '72 water had been obtained from tunnels driven into mountains.

Water Supply.—Hobart creek, 29 miles distant, by gravity from an impounding to distributing reservoirs. The drainage area is about 12 sq. m.

Dam.—Forms reservoir; stone masonry, 170 ft. long and 40 ft. high.

Reservoir.—Covers 1,000 acres.

Conduit.—From impounding to distributing reservoirs. For 22 miles it is a plank flume, 16½ by 18 in., with a grade of 20 ft. per mile. Across Washoe valley, between the Sierra Nevada and Mt. Davidson ranges, 7 miles, water is conveyed in two riveted wrought-iron pipes, of 10 and 12 in. diam.; at the lowest point these pipes are under a head of 1,720 ft.

Distributing Reservoirs.—Cap., 26,000,000, 8,300,000 and 3,800,000 galls. respectively. The second is in rock excavation, 270 by 300 ft., by 15 ft. deep at 350 ft. above Virginia City. The third is in earth excavation, 170 by 180 ft., by 8 ft. deep, at 150 ft. above Gold Hill.

Distribution.—*Mains*, w. i., 26 miles. *Services*, w. i. *Taps*, 2,300; 1,525 in Virginia City, 600 in Gold Hill, and 175 in Silver City. Only about ⅝ of these are now in use. *Meters*, not given; put on where waste is suspected, and removed when the question is settled. *Hydrants*, 130; 92 in Virginia City, 26 in Gold Hill, and 12 in Silver City.

Consumption, 8,600,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 130 lbs.

Financial.—Cost, about $2,800,000. Bonded debt, $500,000. Int., not given. Ann. op. exp., $53,000. Ann. rev.: consumers, $236,000; cities, $5,460. Hydrant rental: $39.24 each in Virginia City, $57.69 in Gold and $30 each in Silver City.

Management.—Prest., W. S. Hobart. Secy., W. W. Stetson. Supt., J. B. Overton.

WINNEMUCCA, *Humboldt Co.* (Pop., 763: est., 1,400.) On Humboldt river, in mining district. Settled about '70.

History.—Built in '77 by company. Des. Engr., J. Culver.

Water Supply.—Cross canyon, by gravity.

Storage Reservoir.—Cap., about 1,000,000 galls.; in canyon, 100 ft. sq. by 16 ft. deep, at 950 ft. above town.

Conduit.—Of 7 in. wrought-iron pipe, to distributing reservoir.

Distributing Reservoir.—Cap. not given: 125 ft. above town.

Distribution.—*Mains*, w. i., 3 miles. *Services*, w. i. *Taps*, 160. *Meters*, none. *Hydrants*, 17.

Consumption, 250,000 galls. *Pressure*: 60 lbs.

Financial.—Cost, $20,000. No bonded debt. Ann. op. exp., $1,000. Ann. rev.: consumers, withheld, but est., $3,000; city, not given.

Management.—Address J. B. Gram or A. T. Gilson.

NOTE.—No report given since '84.

UTAH.

Water-Works Completed or in Process of Construction.

LOGAN, *Cache Co.* (Pop., 3,396; est., 6,000.) On Logan river, on three plateaux rising from the river. Has water-power. Settled in '59; incorp. a city in '66.

History.—Built in '79-80 by city. Des. Engr., Jas. H. Martineau. Const. Engr., David J. James, Salt Lake City.

Water Supply.—Logan river, by gravity, from a point 2½ miles above town, through two settling basins to reservoir.

Conduits.—A canal, 20 ft. wide at bottom, and 1¾ miles long, leads to first settling basin, which is connected with the second by a flume 12 by 16 in., and 1,100 ft. long, of 2-in. pine plank laid 5 ft. below, the surface for a part of the distance, and by a conduit of stone in cement for the remainder. The second basin and the reservoir are connected by 1,300 ft. of pipe.

Settling Basins and Reservoir.—Former are not described in report. The reservoir is 20 by 65 ft., by 12 ft. deep, in excavation with 2-ft. stone walls in cement and with concrete bottom. It is in six compartments, water passing through the three on either side of a central wall, with screens between each, so that either side can be cleaned while the other is in use. The reservoir is 103 ft. above the main part of the city, and 130 ft. above the lower part.

Distribution.—*Mains*, c. i., wood, 3 miles. *Services*, galv. i. *Taps*, 20. *Meters*, none. *Hydrants*, Ludlow, 14. *Valves*, Ludlow.

Consumption, 240,000 galls. *Pressure*: 50 lbs.

Financial.—Cost, $11,000. No debt. Ann. op. exp., $700. Ann. rev: consumers, $700.

Management.—Supt., Jas. Adams.

OGDEN, *Weber Co.* (Pop., 6,069; est., 10,000.) At junction of Ogden and Weber rivers, 4,200 ft. above the sea. Has manufactories. Settled in '50; incorp. in '51.

History.—Owned by city; built in '80-2 by company. Contrs., Jos. A. West and David Jenkins.

Water Supply.—Ogden river, by gravity. The river rises in the Wahsatch Mts.

Dam and Reservoir.—Cap., 275,000 galls.; on river, the dam being 5 ft. high and the water surface 250 ft. above lowest, and 100 ft. above highest part of city.

Supply Conduit.—Of 8-in. Horton wood pipe, about three miles long.

Distribution.—(In '84.) *Mains*, Horton wood, 13 miles. *Services*, galv. i. *Taps*, 310. *Meters*, 1. *Hydrants*, kind not given, 39.

Consumption, 345,600 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs.

Financial.—Cost, $100,000. Debt, not given; none in '84. Ann. op. exp., $1,500. Ann. rev.: total, $12,000.

Management.—Com. Supt., Job Pingree.

PARK CITY, *Summit Co.* (Pop., 1,542.) On Silver creek, ground rising steeply each way from stream. A mining town. Settled in '70; not incorp.

History.—Built in '80 by private company. Des. Engr., W. M. Ferry.

Water Supply.—A mountain stream, one mile from town, by gravity.

Dams and Reservoirs.—Three dry stone dams on brush and filled in on each side with coarse gravel are built across the creek, forming as many reservoirs, the combined cap. being 1,000,000 galls. Water falls 12 ft. over first dam to second reservoir, and also over second reservoir to third. A tight box flume passes under the two lower dams so that the two upper reservoirs can be cleaned or emptied without disturbing the lower. The lower reservoir is about 200 ft. above city.

Distribution.—*Mains*, Horton wood, 3 miles. *Services*, galv. i. *Taps*, 237. *Meters*, none. *Hydrants*, kind not given, 11.

Consumption, unknown. *Pressure*: 86 lbs.

Financial.—Cost, $19,000. No debt. Ann. op. exp., $360. Ann. rev.: consumers, $4,101; city, none.

Management.—Not given.

NOTE:—No report given since '84.

SALT LAKE CITY, *Salt Lake Co.* (Pop., 20,768; est., 30,000.) On Jordan river, 4,320 ft. above the sea. Part of the city is on a nearly level plain and the remainder on a mountain bench. Streets are each 132 ft. wide. Settled in '47; incorp. a city in '51.

History.—Built by city in '74. Des. Engr., Thos. W. Ellerbeck.

Water Supply.—City creek, by gravity. The creek has a drainage area of 30 sq. m., and is fed by springs and melting snow. In the summer much water is used for irrigation, it being carried along the gutter each side of the street.

Dam.—Of timber, across creek, to divert water into conduit.

Supply Conduit.—Of redwood, 2½ by 4½ ft., leading to tanks or reservoirs.

Reservoirs.—Six, combined cap., 400,000 galls.; the first two were 16½ by 29¾ ft., and 15½ by 28 ft., each 10 ft. deep, at about 180 ft. above the northern, and 225 ft. above the southern and western parts of the city.

Distribution.—*Mains*, 30 to 3-in. c. i., 24.4 miles; from Dennis Long & Co., Louisville, Ky., for extension of 10 miles made in '88. *Services*, lead. *Taps*, 2,130. *Meters*, none. *Hydrants*, made by Davis Howe & Co., Salt Lake City. *Gates*, Coffin.

Consumption, 10,000,000 galls., including water used for irrigating purposes. *Pressure*: Ordinary. 86 lbs.

Financial.—Cost, $411,000. Debt, not given. Ann. op. exp., $8,530. Ann. rev.: consumers, $20,381; city, $11,456.

Management.—Supt., G. M. Ottinger.

IDAHO.

Water-Works Completed or in Process of Construction.

BELLEVUE, *Alturas Co.* (Pop., est., 1,600.)

History.—Built in '87 by Bellevue Water Co., under a perpetual franchise; charter is for 49 years. Des. Engr., John Corkish, Portland, Oregon. Const. Engr., Jas. B. Wolfe.

Water Supply.—Mountain stream, by gravity from impounding reservoir, formed by small dam across stream.

Dam and Reservoir.—Not described.

Distribution.—*Mains*, wood, 5 miles; from Puget Sound Pipe Co., Olympia, W. T. *Services*, not given. *Taps*, 140. *Meters*, not given. *Hydrants*, 8.

Pressure: Ordinary. 60 lbs. Fire, 80 lbs.

Financial.—Cost, $15,000. Capital stock, $30,000. No debt. Ann. op. exp., $750. Ann. rev.: consumers, $4,200; city, $320. Hydrant rental, $40 each.

Management.—Prest., H. E. Miller. V. Prest., J. M. Kinnear. Secy., H. F. Baker. Treas., N. O. DeLano. Supt., G. B. Pinkham.

EAGLE ROCK, *Bingham Co.* (Pop., est., 250.)

History.—Built in '85 by Eagle Rock Water-Works Co. Engr., C. H. Clark. Labor done by company.

Water Supply.—Snake river, pumping to tanks.

Pumping Machinery.—Dy. cap., 144,000 galls.; No. 8 Knowles pump, driven by Halladay windmill, with a Shapley boiler for reserve.

Tanks.—Two, dy. cap., 35,000 galls. each.

Distribution.—*Mains*, c. i., w. i., 1½ miles. *Services*, w. i. *Taps*, 20. *Meters*, 1. *Hydrants*, 4.

Consumption, 35,000 galls. *Pressure*: Ordinary, 20 lbs. Fire, 100 lbs.

Financial.—Cost, $8,000. Capital stock, $8,000. Debt, $2,000. Int., 12%. Ann. op. exp., $1,700. Ann. rev.: consumers, $1,700. Hydrants free.

Management.—Prest., J. M. Bennett, Pocatello. Secy., W. H. B. Crow.

HAILEY, *Alturas Co.* (Pop., est., 2,000.) On Wood river in mining country.

History.—Built in '84 by Alturas Water Co.

Water Supply.—Indian creek, by gravity.

Reservoir.—Cap., 250,000 galls.; in embankment, 110 ft. above town.

Distribution.—*Mains*, kal. i., 2 miles. *Services*, w. i. *Taps*, 140. *Meters*, none. *Hydrants*, Ludlow, 5.

Consumption, not given. *Pressure*: 36 lbs.

Financial.—Cost, $15,000. Capital stock and bonded debt, not given. Ann. op. exp., $500. Ann. rev.: consumers, $4,700. Hydrants free.

Management.—Prest., E. A. White. Secy., Alex. Willman.

POCATELLO, *Bingham Co.* (Pop., est., 1,200.)

History.—Built in '82 by Union Pacific Ry. Co.

Water Supply.—Mountain springs, by gravity to tank.

Tank—Cap., 50 000 galls.; of wood, 16 by 24 ft.

Distribution.—*Mains*, c. i., about 2 miles. *Services*, w. i. *Taps*, 45. *Meters*, none. *Hydrants*, 15.

Financial.—Cost, $10,000. Ann. op. exp., $300. No revenue.

Management.—Supt., J. M. Bennett.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Lewiston, *Nez Perces Co.*

GROUP 9.—CANADA MARITIME PROVINCES.—Water-Works completed, in Process of construction or Projected, in New Brunswick, Nova Scotia, Prince Edwards Island and Newfoundland.

NEW BRUNSWICK.

Water-Works Completed or in Process of Construction.

CARLETON, *St. John Co.* (Pop., 4,800; est., 5,000.) On River St. John, on uneven ground in rocky district. Settled in 1783; incorp. a city in 1785.

History.—Built in '60 by city. Des. Engrs., Hurd Peters and J. Edward Boyd.

Water Supply.—Spruce, Ludgate and Menzie lakes, by gravity to reservoir. The Lakes have a combined area of 4 sq. m., and are 6 miles from and 130 ft. above city.

Dam.—Of earth, at outlet of lakes.

Filter.—Of gravel at dam.

Supply Conduit.—Of 12-in. cement-lined wrought iron, 6 miles.

Reservoir.—Cap., 2,000,000, galls.; in excavation and embankment, 160 by 180 ft., by 20 ft. deep.

Distribution.—*Mains*, w. i. and cement, 6.3 miles. *Services*, w. i. *Taps*, 400. *Meters*, none. *Hydrants*, "home made," 33.

Consumption, 300,000 galls. *Pressure*: Ordinary, 30 lbs. Fire, 65 lbs.

Financial.—Cost, $131,000. Bonded debt, $131,000. Ann. op. exp., $2,000. Ann. rev.: consumers, $3,500; city, none.

Management.—Chn. Com., Geo. F. Harding. Supt., I. Alfred King.

FREDERICTON, *York Co.* (Pop., 6,006; est., 6,500.) On River St. John. Settled about 1780.

History.—Built in '82-3 by city. Engrs., Crafts & Forbes, Boston, Mass. Most of the labor done by local Contrs.

Water Supply.—River St. John, pumping to stand-pipe and direct.

Intake.—Water passes from the river for a distance of about 600 ft. from high water mark through a trench filled with broken stone to a crib-well, and from this through 600 ft. of 16-in. cast-iron pipe to the pump-well.

Pumping Machinery.—Holly-Gaskill pump, dy. cap., 1,500,000 galls.

Stand-Pipe.—Cap., about 40,000 galls.; 15 ft. in diam. by 31 ft. deep.

Distribution.—*Mains*, c. i., 9 miles. *Services*, enam. i. *Taps*, 740. *Meters*, none. *Hydrants*, Coffin, 81. *Valves*, Coffin.

Consumption, 750,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 70 lbs.

Financial.—Cost, $100,000. Bonded debt, $100,000. Int., 5%. Ann. op. exp., $5,114. Ann. rev.: consumers, $4,557; city, $1,600.

Management.—Supt., Alex. Burchill.

MONCTON, *Westmoreland Co.* (Pop., 5,032; est., 9,000.) On Petitcodiac river. Has sugar refinery and cotton factory. Settled in 1770; incorp. a town in '55, a city in '75.

History.—Built in '78 by Moncton Gas Light and Water Co. Des. Engrs., Gilbert Murdoch, St. John, and E. H. Keating, Halifax, N. S. Const. Engrs., W. J. Crossdale and Jno. Ellington. Most of labor done by the day.

Water Supply.—Northwest branch of Hall's creek, by gravity from impounding reservoir, formed by dam across stream. The creek has a drainage area of about 23 sq. m.

Dam.—Of earth founded on rock; 35 ft. high, about 400 ft. long, with puddle core 15 ft. wide at bottom and 10 at top.

Reservoir.—About 400 ft. wide and two miles long, at 135 ft. above city. This is formed by above dam. A reservoir area of 75 acres is reported, but no further description given.

Supply Conduit.—Of 20 to 12 in cast-iron, leading to town; length not given.

Distribution.—*Mains*, c. i. about 9 miles. *Services*, lead. *Taps*, 500. *Meters*, none. *Hydrants*, Mathews, 27. *Valves*, Eddy.

Consumption, est., 400,000 galls. *Pressure*: 42 lbs.

Financial.—Cost, $100,000. Debt, about $30,000. Int., 6%. The total stock of the company is $100,000, and bonds, $60,000, on both gas and water plant. Ann. op. exp.

withheld, but est., $2,500. Ann. rev.: consumers withheld, but est., $10,000.

Management.—Prest. and Mgr., J. L. Harris. Secy., R. A. Bard. Treas., C. P. Harris.

MILLTOWN, *Charlotte Co.* See St. Stephens.

PORTLAND, *St. John Co.* See St. John.

SAINT JOHN and PORTLAND, *St. John Co.* (Pop.: St. John, 28,895; est., 45,000. Portland, 12,520: est., not given.) St. John is on Bay of Fundy at mouth of River St. John, on rocky peninsula with steep slopes. Settled in 1780; incorp. a city in 1785. Portland adjoins St. John, and was settled later.

History.—Now owned by the two cities. Works were built in '36 by a private company, and abandoned with the completion of new works built in '49-50. In '55 the city bought the works. Engr. for works built in '49-50, Geo. H. Bailey; for late improvements, Gilbert Murdoch.

Water Supply.—Little river and Lake Latimer, by gravity from impounding reservoir on former. A dam at the outlet of the lake makes its waters available. This was built in '51. The lake has an area of 200 acres, and is 300 ft. above city datum. A conduit brings water from lake to river.

The supply from '36 to '50 was from Lily lake, a natural pond 80 ft. above base of city levels, and about two miles from city. Water was raised 63 ft. to a 300,000,000 gall. masonry reservoir, the steam pump being operated three or four times a week. Water was admitted to the distributing pipes only from 6 to 8 A. M.

Impounding Reservoir.—On Little river, with area of 37½ acres, at 160 ft. above city datum.

Lake Latimer Dam and Conduit.—Not described.

Supply Conduits.—The first was of 12-in. cast-iron. In '57, and again in '73, a 24-in. pipe was added.

Distribution.—*Mains*, c. i. 47.7 miles. *Services*, lead, 23.55 miles. *Taps*, 14,624. *Meters*, Crown, Worthington, 138. *Hydrants*, department design, 288. *Valves*, kind, do.

Consumption, 4,744,600 galls. *Pressure*: 40 lbs.

Financial.—Cost, $1,011,797. Debt, $1,011,797. Int., 4, 5 and 6%. Ann. op. exp., $12,332. Ann. rev. total, $85,948; $74,753 by assessment, and $11,195 by agreements.

Management.—Three Comrs., two from St. John, and one from Portland. Chn. Comrs., A. Chipman Smith. Supt., Gilbert Murdoch.

SAINT STEPHENS and MILLTOWN, *Charlotte* Co. (Pop., est., 6,000.) On St. Croix river, opposite Calais, Me. Engaged in manufacturing.

History.—Built in '86-7 by St. Croix Water Co., under 20 years' franchise.

An extension of the Calais (Me.) Water Co.'s system, which see for description of pumps and reservoir.

Distribution.—*Mains*, c. i., 15 miles; from Warren Foundry & Machine Co., Phillipsburg, N. J. *Services*, tarred w. i.

Financial.—Capital stock, $200,000. Bonded debt, $100,000. Int., 5%. Hydrant rental, $50 each.

Management.—Prest., Weston Lewis. Secy., Josiah Maxcy, Gardiner, Me. Supt., H. W. Rogers.

NOTE:—Other figures not given.

WOODSTOCK, *Carleton Co.* (Pop., 3000, est., 3,200.) On hilly ground on River St. John. Engaged in manufacturing. Settled in '20; incorp. a town in '55.

History.—Built in '84 by town. Engrs., Crafts & Forbes, Boston, Mass.

Water Supply.—River St. John, by direct pumping.

Filter.—Water passes through 5 ft. of loose stone to pump-well.

Pumping Machinery.—Dy. cap., 1,700,000 galls.; pump has 11-in. bucket and 8-in. plunger of 14-in. stroke, and is driven by engine made by the Burrell Johnson Iron Co. There are two boilers, each 10 ft. long: one is 3½ and the other 4½ in. diam.

Distribution.—*Mains*, c. i., 5¾ miles. *Services*, enam. i. *Taps*, 450. *Meters*, 19. *Hydrants*, kind not given, 79.

Consumption, 93,000 galls. *Pressure*: Ordinary, 63 lbs. Fire, 92 lbs.

Financial.—Cost, $65,000. Debt, $65,000. Int., 4½%. Ann. op. exp., $2,800. Ann. rev.: consumers, $4,000; city none.

Management.—Supt., D. Munro.

NOVA SCOTIA.

Water-Works Completed or in Process of Construction.

AMHERST, *Cumberland Co.* (Pop., 2,000; est., 3,500.) Engaged in mining, manufacturing and ship-building.

History.—Built in '87-8 by Amherst Water-Works Co., Ltd. Engr., James King.

Water Supply.—Springs, by gravity to reservoir.

Reservoir.—Cap., 10,000 galls.

Distribution.—*Mains*, 3 in. spruce, 4 miles. *Services*, galv. i. *Taps*, 50 to 60. *Meters* and *Hydrants*, none.

Consumption, 6,000 galls. *Pressure*: Ordinary, 20 lbs. Fire 42 lbs.

Financial.—Cost, $5,000. Capital stock, $10,000. No debt. Ann. op. exp., $300. Revenues: not given.

Management.—Prest., G. B. Smith. Supt., James King.

BRIDGETOWN, *Annapolis Co.* (Pop., 800; est., 2,000.) On Annapolis river, at head of navigation.

History.—Built in '87 by town. Engr., A. W. Forbes, Boston, Mass. Contrs. Sutherland & Corcoran, Kentville.

Water Supply.—Three springs, by gravity to reservoir.

Reservoir.—Cap., 750,000 galls.

Distribution.—*Mains*, 8 to 2 in. c. i., 4 miles; from Black & Co., Glasgow, Scotland, and Bridgetown Foundry; coated with Dr. Angus Smith's preparation. *Services*, galv. i. *Taps*, 60. *Meters*, none. *Hydrants*, from Windsor Foundry, 21.

Consumption, 15,000 galls. *Pressure*: 100 lbs.

Financial.—Cost, $20,000. Debt, $19,500. Int., 5%. Ann. op. exp., $1,400. Ann. rev.: consumers, $800; city, by assessment, $1,100.

Management.—Board of Fire Wardens. Supt., John L. Cox.

HALIFAX, *Halifax Co.* (Pop., 36,000; est., 45,000, including army and navy.) On a peninsula, on a hillside rising steeply from the harbor, the western part being on undulating ground 100 to 250 ft. above the sea. Settled in 1749.

History.—Now owned by city. Built in '45-8 by private company, when population was about 20,000. Des. Engr., Jno. B. Jervis. Const. Engr., Chas. R. Fairbanks. In '61 the city bought the works for about $275,000. In '68 a high service supply was introduced, in accordance with the advice of Thos. C. Keefer. Since '72 extensions have been made under the direction of the Engr. and Supt., E. H. Keating.

Water Supply.—Long, Upper and Lower Chain lakes for low, and Spruce lakes for high service, by gravity. A dam across the south end of Long lake impounds the drainage of 6 sq. m., increases the lake surface to 400 acres, and gives a storage cap. of 690,000,000 galls. From this water passes through Upper to Lower Chain lake, which is 200 ft. above the sea, and 3½ miles from the city.

The Spruce Hill lakes, have an area of 170 acres, are 360 ft. above the sea, and 9 miles from the city.

In '74 the Spruce Hill lakes became contaminated with vegetable matter, their surface being covered with a bright green powder, a green slime forming around the shores, and the water having an offensive odor. Late in the summer the lakes were drawn down as low as possible, brush, fallen trees and stumps removed from the shores of the lake, and for 20 ft. back, and the banks sown to grass. This remedied the nuisance.

In '78 analysis of water from Long and Lower Chain lakes showed 5.49 parts of solids to 100,000 in Long, and 7.31 in Lower Chain lake. It was found that the increase was due to a deposit of the remains of infusoria covering the whole bottom of Upper Chain lake for seven feet. It varied in consistency from "that of soft cheese to common bakers' bread," and in color from "whiteish or light skin color to dark ferrugenous brown, some pieces being nearly black. Mr. Keating advised that the supply main be extended to Long lake, but to '81 this had not been done.

Long Lake Dam.—Is 1,000 ft. long and 31 ft. high, partially or wholly of masonry. No further details given.

Supply Conduits.—The first one laid from Lower Chain lake to the city was 10 or 12 in. in diam. In '56 a 15-in. pipe was added, and in '62 the first one replaced by a 24-in. main. From Lower Spruce Hill lake a 20-in. main was laid for one mile, then reduced to 15 in. and continued to a junction with the 12-in. main laid from Long lake in '56.

Oxidization of Iron Pipes.—Much trouble has been experienced from this cause, the incrustation varying in thickness from ½ to 1 in. In '76-7 about 7 miles of 3-in. pipe were cleaned by hand scrapers at a contract price of 14.3 cents for 1 lin. ft. In '80 the 12-in. supply main, laid in '48, was cleaned by a self-acting machine, and since more pipe has been cleaned, all with good success. The scraper was inserted in the pipe, and carried forward by the flow of water for from ¾ to 2 miles, sweeping all accumulations before it, including rust, stones, pieces of broken pipe and of lead. For description of the process, with illustrations, see paper by E. H. Keating, in Trans. Am. Soc. C. E., vol XI., pp. 125 to 150.

Distribution.—*Mains*, c. i., about 60 miles; that used in construction was from Scotland. *Services*, lead. *Taps*, about 5,000. *Meters*, 6. *Hydrants*, now made by city. 325. *Valves*, kind; do.

Consumption, about 6,500,000 galls. *Pressure*: 10 to 60 lbs.

Financial.—Cost, $800,000. Debt, $800,000. Int., 4½ to 6%. Ann. op. exp., about $15,000. Ann. rev.: consumers, $65,000, including that from army and navy.

Management.—Board of Works. Supt. and Engr., E. H. Keating.

KENTVILLE, *Kings Co.* (Pop., 1,779; est., 3,000.) On Cornwallis river.

History.—Built in '87 by city. Engr., A. W. Forbes, Boston, Mass. Contr., Wm. Sutherland, Kentville, N. S.

Water Supply.—Mill brook, by gravity to reservoirs.

Reservoirs.—Combined cap., 520,000 galls.; a 500,000-gall. and a 20,000-gall. reservoir.

Distribution. — *Mains*, c. i., 6 miles; from Black & Co., Glasgow, Scotland. *Taps* and *Meters*, not given. *Hydrants*, Chapman, 25. *Valves*, Chapman.

Pressure: 100 lbs.

Financial.—Cost, $27,000. Debt, $20,000. Int., not given. Ann. op. exp. and rev., not given.

Management.—Supt., F. A. Bayley.

TRURO, *Colchester Co.* (Pop., 3,512; est., 6,000.) At head of Cobequid bay. Has manufactories.

History.—Built in '75 by town.

Water Supply.—Surface water, by gravity, with direct pumping for fire purposes.

Reservoir.—Cap., about 25,000,000 galls.; about 120 by 3,000 ft., by 10 ft. deep.

Pumping Machinery.—Not described.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i., enam. i., lead. *Taps*, 300. *Meters*, none. *Hydrants*, Holly, 35. *Valves*, Eddy.

Consumption, not given. *Pressure*: Ordinary, 63 to 75 lbs. Fire, 103 lbs.

Financial.—Cost, $40,000. Debt, $40,000. Int., 5½%. Ann. op. exp., about $900. Ann. rev.: total, about $1,400.

Management.—Engr., A. L. Archibald.

WINDSOR, *Harts Co.* (Pop., 3,000; est., 3,500.) On Avon river, near quarries of limestone and gypsum. Engaged in ship-building, and manufacturing cotton, iron and woolen goods. Incorp. a town in '78.

History.—Built in '83 by town. Engr., E. B. Keating, Halifax. Labor mostly done by the day.

Water Supply.—Brook, by gravity from impounding reservoir.

Dam.—Of wood, 128 ft. long and 17 ft. high.

Reservoir.—Covers about 5 acres, at 185 ft. above high tide.

Distribution.—*Mains*, c. i., 10 miles; imported from Scotland. *Services*, w. i. lead. *Taps*, 500. *Meters*, none. *Hydrants*, designed by E. H. Keating, 47.

Consumption, not given. *Pressure*: 86 lbs.

Financial.—Cost, $54,000. Debt, $52,000. Int., 5%. Ann. op. exp., $635. Ann. rev.: consumers, $3,200; city, $1,000 for sinking fund.

Management.—Chn. Com., Jas. E. Graham. Supt., G. Parker Smith.

YARMOUTH, *Yarmouth Co.* (Pop., 3,500; est., 7,000.) At entrance of Bay of Fundy. Has manufactories.

History.—Built in '81 for domestic supply by Yarmouth Water Co. Des. Engr., E. Wasell.

Water Supply.—Lake George, by gravity. The lake is 9 miles long, has an average width of 1½ miles, and is 150 ft. above town.

Distribution.—*Mains*, c. i., 20 miles. *Services*, lead. *Meters* and *Hydrants*, none. *Pressure-recording gauge*, Edson.

Consumption, not given. *Pressure*: 37 lbs.

Financial.—Cost, $200,000. Capital stock, $200,000. Debt, not given. Ann. op. exp., $1,500. Ann. rev.: consumers, $3,500; city, none.

Management.—Supt., Geo. H. Robertson.

Water-Works Projected with Fair Prospects of Construction.

DARTMOUTH, *Halifax Co.* (Pop., 4,388.)

Proposed System.—In '88 a report on the proposed water supply was made to the city by E. H. Keating, Halifax, who recommended that water be taken by gravity from Lamont's lake, through a 12 or 18 in. cast-iron supply main, and distributed by 10 to 4-in. pipe. Cost, est., $59,000. Address, Chn. Committee on Water Supply.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

St. Andrews, *Charlotte Co.*

PRINCE EDWARD'S ISLAND.

Water-Works Completed or in Process of Construction.

CHARLOTTETOWN, *Queens Co.* (Pop., 11,485; est., 12,000.) On Hillsborough river, with good harbor. Engaged in manufacturing and trade.

History.—Built in '88-9 by city. Des. Engr., M. M. Tidd. Const. Engr., Freeman C. Coffin. Both of Boston, Mass. Contrs., J. W. McIntosh, Stellarton, J. K. McDonald, New Glasgow and Wm. H. Frazer, Charlottetown.

Water Supply.—Surface well, pumping to reservoir.

Pumping Machinery.—A 2,000,000-gall. Blake pump.

Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, 14 to 6-in. c. i., 15½ miles. From Alliance Foundry, Scotland. *Services*, lead. *Taps*, 195. *Meters*, none. *Hydrants*, Galvin, 88. *Valves*, Galvin.

Pressure: Ordinary, 58 lbs. Fire, 85 lbs.

Financial.—Cost, $165,000. Debt, $165,000. Int., 5%. Revenues: not given.

Management.—Commrs.: Chn., David Laird, John Kelly and A. McKinnan. Secy., Duncan McLean. Engr., John McDonald.

NEWFOUNDLAND.

Water-Works Completed or in Process of Construction.

CARBONEAR, (Pop., 3,000; est., 5,300.)

History.—Built in '83-4 by Carbonear Water Co. Engr., Jno. Martin, St. John's. Contrs., Jno. Martin and Jno. Foote, Carbonear.

Water Supply.—A small lake, by gravity. The lake is 4 miles from town, and 350 ft. above the sea.

Tank.—I- 3½ by 5½ ft., by 7½ deep.

Distribution.—*Mains*, 16 to 4-in., material not given. *Services*, lead. *Taps*, 39. *Meters*, none. *Hydrants*, kind not given, 19.

Consumption, not given. *Pressure*: Ordinary, 110 lbs. Fire, 150 lbs.

Financial.—Cost, $31,000. Capital stock and bonds, $34,000. Int., 4%. Ann. op. exp., $1,800. Ann. rev.: consumers, $2,000; city, not given. Hydrant rental, "8% on valuation of property."

Management.—Prest., B. T. H. Gould. Treas., Wm. F. Penney. Secy. and Supt., Jas. P. Guy.

HARBOR GRACE, *District of Harbor Grace.* (Pop., 6,770; est., 9,000.) On Conception bay.

History.—Built in '63 by company.

Water Supply.—Bannerman lake, by gravity.

Distribution.—(In '84.) *Mains*, c. i., 5 miles. *Services*, lead. *Taps*, 102. *Meters*, none. *Hydrants*, 38.

Consumption and *Pressure*, not given.

Financial.—(In '84.) Debt, $52,400. Int., 5%.

Management.—(In '84,) Secy., C. Watts.

NOTE:—Requests for information have been ignored since '84.

SAINT JOHN'S, *District of St. John's.* (Pop., 21,000; est., 39,000.) On coast.

History.—Built in '47, and rebuilt, or extended, in '62, by company.

Water Supply.—Windsor lake, by gravity.

Distribution—(In '86.) *Mains*, c. i., 19 miles. *Services*, lead. *Taps*, 2,000. *Meters* none. *Hydrants*, 150.

Consumption, 3,500,000 galls. *Pressure*: 200 lbs.

Financial.—(In '86.) Cost, $412,000. Debt, $412,000. Int., 5%. Ann. op. exp., $10,000. Ann. rev. consumers, $20 900; city, none.

Management.—T. Clift, was Secy. in '86.

NOTE:—Requests for information have been ignored since '86.

GROUP 10.—CANADA INTERIOR and WESTERN PROVINCES.—Water-Works completed, in Process of Construction or Projected, in Quebec, Ontario, Manitoba and British Columbia.

QUEBEC.

Water-Works Completed or in Process of Construction.

BERTHIER, *Berthier, Co.* (Pop., 2,156.) On St. Lawrence river.

History.—Built in '79 by T. U. Foncher.

Water Supply—St. Lawrence river, pumping to tank and direct.

Pumping Machinery and Tank.—Not described.

Distribution.—(In '86.) *Mains*, c. i., 3 miles. *Services*, lead, *Taps*, 300. *Meters*, none. *Hydrants*, 15.

Consumption, not given. *Pressure*: Ordinary, 20 lbs. Fire, 100 lbs.

Financial.—(For '86.) Cost, $22,000. Debt., not given. Ann. op. exp.. $1,000. Ann. rev.: consumers, $2,400; city, none.

Management.—Owner, I. U. Foncher. Town clerk, W. R. Kenney.

NOTE:—Requests for information have been ignored since '86.

COTE SAINT ANTOINE, *Montreal Co.* (Pop., est., 1,500.) A suburb of Montreal. Settled about '81.; now an incorp. town.

History.—Built in '83 by Cote St. Antoine Water Co. Engr. and Contr., J. B. A. Béique.

Water Supply.—Montreal water-works, through meter. In '84 the price was $0.40 per 1,000 galls.

Distribution.—*Mains*, c. i. 3 miles. *Services*, lead. *Taps*, 170. *Meters*, 170. *Hydrants*, kind not given, 4.

Consumption, 12,000 galls. *Pressure*, 25 to 30 lbs.

Financial.—Cost, $17,000. Capital stock, $16,000; $20,000 authorized. No bonds or debt. Ann. op. exp., $911. Ann. rev.: consumers, $2,640; city, $280 for water used at fires and in sprinkling streets.

Managementt—Prest., A. C. Hutchinson. Secy., Treas. and Gen. Mgr., Fred W. Evans.

DRUMMONDVILLE, *Drummond* Co. (Pop., 2.000)

History.—Built in '87-8 by Comtois & Poirier.

Water Supply.—St. Francis river, pumping to reservoir and tanks.

Pumping Machinery.—Cap., 36,000; Contrs., E. A. Roudeau, Sorel P. Q. One ular boiler, 4 by 12 ft.

Reservoir.—Not described.

Tanks.—Each 12 by 6 ft.

Distribution.—*Mains*, wooden, 3 miles; from Jos. La Chappelle, St. Jerome, P. Q. *Services*, wood and lead. *Taps*, 70. *Meters*, none. *Hydrants*, 12.

Consumption, 8,000 galls. *Pressure*: 40 lbs.

Financial.—Cost, $6,000. Debt, $3,000. Int., 9%. Ann. op. exp., $100. Ann. rev.: consumers, $620; city, none.

Management.—Owners, Comtois & Poirier.

HULL, *Ottawa, Co.* (Pop., 6,668; est., 13,000.) On Ottawa river, opposite Ottawa, Ont. Has manufactories.

History.—Built in '86 by town. Engr., Robt. Surtees, Ottawa, Ont. Contrs., Geo. H. Miller & Theophile Vian Hull.

Water Supply.—Ottawa river, at head of Chaudiere falls, pumping to tank and direct.

Pumping Machinery.—A 1,200,000—gall. Knowles pump.

Tank.—Cap., 18,000 galls.

Distribution.—*Mains*, c. i., 7 miles. *Services*, lead. *Taps*, 38. *Meters*, none. *Hydrants*, kind not given, 35.

Consumption, 600,000 galls. *Pressure*: Ordinary, 75 to 80 lbs. Fire 90 lbs.

Financial.—Cost, $95,780. Debt, $90,000; bonded debt, $40,000: $50,000 borrowed on $70,000 of bonds still on market at time of report. Int., 5%. Ann. op. exp., $3,140. Ann. rev. consumers $5,987; city, none.

Management—Secy. and Treas., J. O. Hafeniere. Supt., Ludger Genest. Mech. Engr., Jos. Paris.

JOLIETTE, *Joliette Co.* (Pop., 3,268; est., 4.000.) On L'Assomption river, on level ground. Has manufactories. Settled in '40; incorp. a village in '43; a town in '68.

History.—Built in '73 by town, and rebuilt or extended in '81. Engr., E. N. Chaumette. Contrs., Beauchemin & Sons, Sorel.

Water Supply.—L'Assomption river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; 7-in. rotary water-power pumps built by Dayone & Deblois, and a 7½-in. duplex pump, built by Beauchemin & Sons, Sorel.

Distribution.—*Mains*, 8 to 4-in. c. i., 7 miles; from Jas. Robinson, Montreal. *Services*, lead. *Taps*, 1,200. *Meters*, none. *Hydrants*, kind not given, 32.

Consumption, 300,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 80 lbs.

Financial.—Cost, $42,000. Debt, $42,000. Int., 5½%. Ann. op. exp., $1,100. Ann. rev.: consumers, $6,000.

Management.—Prest. of Com., A. Fontaine. Supt., Pierre Laforest.

LONGUEIL, *Chambly Co.* (Pop., 2,445; est., 3,500.) On St. Lawrence river, opposite Montreal. Incorp. in '74.

History.—Built in '76 by town.

Water Supply.—St. Lawrence river, by direct pumping.

Intake and Pump Well.—A 22-in. pipe conveys water to a pump-well 10 ft. in diam. and 32 ft. deep.

Pumping Machinery.—Dy. cap., 300,000 galls.; one built by Waterous Co., Brantford, Ont , and one from Beauchemin & Sons, Sorel. The latter is of the Worthington type.

Distribution.—*Mains*, c. i., 7½ miles. *Services*, lead. *Taps*, 550. *Meters*, none. *Hydrants*, kind not given, 42.

Consumption, 120,000 galls. *Pressure*: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $80.000. Debt, $80,000. Int., 4%. Ann. op. exp., $2,000. Ann. rev.: consumers, $5,771; city, none.

Management.—Secy. and Treas., L. E. Bourgeois. Supt., J. A. Gariety.

MONTREAL, *Montreal Co.* (Pop., 140,682; est., 200,000.) On island at confluence of Ottawa and St. Lawrence rivers, on gentle slope at foot of a mountain rising 750 ft. Founded by French in 1642.

Historical Summary.—Works are now owned by city, the original works having been built by a company in '01, sold to a second company in '16, to a third in '32 and to the city in '45. In '53-6 the city built the new works.

THE WORKS FROM '01 TO THEIR PURCHASE BY CITY IN '45.

The first works were built in '01, when the population was about 10,000, by the

"Company of the Proprietors of the Montreal Water-Works. This company was incorp. for 50 years, with a capital stock of about $40,000. It brought water from springs at the rear of the mountain to two reservoirs, and distributed it in the town. Wooden pipes were used, but did not prove satisfactory. The supply being insufficient, and the pipes failing, the company sold out in '16 for about $20,000. The new company replaced the wooden pipe with 4-in. iron, abandoned the springs, and pumped water to wooden cisterns on Citadel hill, using steam pumps placed on the site of the present works.

The cisterns failed in '27, and were replaced with others, of wood, lined with lead. The latter were 97 ft. above the river, and had held 240,000 galls.

In '32, the 4 in. pipes proving insufficient, the works were sold for about $75,000 to a third company, who replaced principal mains with 10-in. iron pipe, and also the old engines by new ones. In '43, three engines were in use, but only one was used wholly for pumping, it having a dy. cap. of 1,272,000 galls. One of the others was used to drive a grist mill, and to pump, and the third to draw lead pipe.

To Feb. 1, '43, 14 miles of pipe had been laid. There were three taps for the sale of water to carters, and 16 fire plugs.

In '45 the city bought the works for about $250,000. The third company expended about $50,000 on the works, aside from the purchase price.

THE WORKS FROM '45 TO '53.

In '45 the city extended the intake to deep water in the river. In '49 it built a a reservoir at Côteau Baron, with a cap. of 3,000,000 galls., at 139 ft. above the river. It finally became of no value for distribution, and in '76 it was abandoned.

THE PRESENT WORKS.

History.—Built in '53-6 by city. Engrs., Thos. C. Keefer, Ottawa, Ont., and Louis Lesage, Montreal, with W. J. McAlpine and Jno. B. Jervis as Consulting Engrs. Louis Lesage was Supt. and Engr. from '53 to the time of his death in '89.

Water Supply.—St. Lawrence river, through canals to pumps, thence by pumping to reservoirs and direct. The supply introduced in '53-6 is from a point one mile above Lachine rapids, at an elevation of 37 ft. above the summit level of Montreal harbor.

Canal.—The first one is 1¾ miles long, 20 ft. wide at the bottom, 40 at the top, 8 ft. deep, and has a grade of 2½ ft. per mile. It '66 it was found that the original sectional area of the canal had been considerably reduced by slides in the banks.

In '74 a new canal was begun, after plans by Louis Lesage, approved by Wm. J. McAlpine. It is 60 ft. wide at the bottom, 148 at the top, 13 ft. deep, has side slopes of 3 to 1, and falls 3 ins. to the mile. In '78, 4,800 ft. of this canal was completed, it connecting with the old one at that distance from the river.

In the first canal backwater and anchor ice caused much trouble, and for several winters a channel had to be cut through the ice in the entrance to the channel. The entrance was deepened in '63, doing away with anchor ice, but the ice in the canal reduces its capacity one-third.

The report for '86 mentions a canal five miles long.

Pumping Machinery.—Dy. cap., 31,500,000 galls., with an additional 2,500,000 gall. for high service. Both water-power and steam are used to drive the pumps, 14% of the water used in '86 having been pumped by steam. The water-wheels were built by Wm. Fairbairn & Son, Manchester, Eng., Jno. McDougal, Montreal, and W. P. Bartley & Co., Montreal. The engines were built by W. E. Bartley & Co., and E. E. Gilbert, both of Montreal, and Henry R. Worthington, New York City.

In '56 two breast water-wheels were put in use, each 20 ft. in diam. and 22 ft. wide, working under a 20-ft. head and fall. In '64 a turbine wheel was added, and in '74 one of the old breast wheels was replaced by a second turbine.

In '75 a 5,000,000-gall. Worthington pump was put in at the McTavish St. reservoir. In '69 new pumps with a dy. cap. of 3,500,000 galls. were put in operation.

In '72 a compound engine was added, having 44 and 26-in. cylinders. In '73 a duplex high-pressure engine was connected with first turbine for use in winter months. In '74 an 8,000,000 and in '85 a 12,000,000-gall. Worthington pump was added, and in '88 a Gilbert pump was put in operation, having a contract cap. of 2,500,000 galls.

Reservoirs.—*Low Service*: Cap., 35,000,000 Imp., or about 43 000,000 U. S. galls.;

on McTavish street, about 200 ft. above the harbor. It was built in '53-6 with a cap. of 15,000,000 galls., and enlarged to its present size in '62-78.

High Service: Cap., 1,570,000 Imp., or 1,880,000 U. S. galls.; built in '75 at head of Peel St., and is 80 by 200 ft., by 10 ft. deep, at 230 ft. above the low service reservoir, or 530 ft. above the harbor.

Distribution.—*Mains*, c. i., 150 miles. *Services*, lead. *Taps*, 32,176. *Meters*, 600. *Hydrants*, kind not given, 1,043.

Consumption, 13,055,000 Imp., or about 15,000,000 U. S. galls. *Pressure*: 30 to 80 lbs.

Financial.—Cost $6,400,000. Debt, in '86, $6,000,000. Int., 7, 6, 5 and 4%. Ann. op. exp., $90,000. Ann. rev.: consumers, $545,700.

Management.—Acting Supt., B. D. McConnell. Pumping Engr., D. Kearney.

QUEBEC, *Quebec Co.* (Pop., 62,447; est., do.) On St. Lawrence river, on a promontory at mouth of St. Charles river. A point called Cape Diamond is 333 ft. above the river. The upper town is on elevated table land, and the lower, on a narrow belt along the St. Lawrence, backed by a cliff, and a strip on the St. Charles 2,000 ft. wide, of more gradual ascent. Founded in 1608; incorp. a city in '41.

History.—Built in '51-3 by city, when population was about 40,000, and new works built in '82. Des. Engr. of former, Geo. R. Baldwin, Quebec; of latter, C. Baillarge, who has been Supt. and Engr. since '66. Contr., [not stated whether for old or new works], H. T. Beemer.

Water Supply.—St. Charles river, by gravity. A dam across the river at Lorette, 8 miles from the city, diverts water to a subsiding reservoir, from which a conduit leads to city. The head of water at the reservoir is 486 ft. above base, or high spring tides of St. Lawrence river. About 3 miles above the dam the river widens into Lake St. Charles. The drainage area of the river above the dam is 112 sq. m.

Dam.—Masonry, 200 ft. long, 10 ft. high, 8½ ft. wide at bottom and 6 ft. wide on top.

Subsiding Reservoir.—Not described.

Supply Conduit.—In '81 this consisted of 40,969 ft. of 18-in. cast-iron pipe, in 9-ft. lengths, with bell and spigot joints run with lead, the lead staved, as in some parts the pressure is 200 lbs. The thickness of pipe varies with pressure, from 1¼ to ⅞ in.

River Crossing and leak in same.—Near the city the conduit crosses the St. Charles river by means of a pipe-arch bridge of 120-ft. span, the pipe being surrounded by wood.

Originally the pipe was imbedded in concrete and timber, 5 ft. below low water. In '72 it was found that a lead joint had blown out, and that there was a hole 1½ in. in diam. in the spigot end of the pipe at that joint. The jet from this hole was under a pressure of 210 lbs., and had cut 3 in. into the wooden box and nearly through a 7-in. post. The pipe was repaired by banding it with a cast-iron sleeve with a lead joint. Within a year a hole 2 in. wide had been cut through the sleeve, and the defective pipe was thereafter cut out and replaced.

Waste of water and incrustation in pipe.—As early as '60 complaints of an insufficient supply were made, and experiments afterwards conducted by Thos. C. Keefer, showed excessive waste, the lowest average night delivery in April being 88% of the highest average day delivery.

The supply was also diminished by tubercular formation in the pipes. In '65 G. R. Baldwin found that the supply conduit was practically reduced from 1.5 to 1.28 ft. in diam., by incrustation.

Distribution.—*Mains*, c. i., 32.8 miles. *Services*, lead. *Taps*, 5,985. *Meters*, none. *Hydrants*, Chapman, 240. *Valves*, Chapman.

Consumption, 10,000,000 galls. *Pressure*: 83 lbs.

Financial.—Cost, $2,000,000. Debt, $1,750,000. Int., 5, 6 and 7%. Ann. op. exp., about $25,000. Ann. rev.: consumers, $126,581.

Management.—Engr. and Supt., C. Baillarge.

NOTE:—In *Engineering News*, vol. V., pp. 148, 156, 163, 173 there are lengthy extracts from the Report of Preliminary Examination made by the Engineer Geo. R. Baldwin to the Mayor of Quebec, Apr. 3, '48, regarding the introduction of a water supply, and also a description of the works, as they were in '78, by Chas. Baillarge, the Engr. The papers contain many interesting facts, and are accompanied by a sheet of drawings from illustrations accompanying Mr. Baldwin's report, showing the route, profile and details of the conduit as then proposed, and also the gate-house and dam.

SAINTE CUNEGONDE, (Pop.,'83, 6,000.) Near Montreal, on St. Lawrence river. Settled in '74; incorp. a city in about '76.

History.—Built in '79 by Berger & Béique, who also did the work. Des. Engr., J. A. Y. Beaudry.

Water Supply.—St. Lawrence river, by direct pumping. The supply for St. Henri is drawn from this system.

Intake.—A stone crib 75 ft. long, 32 ft. wide and 25 ft. deep extends into the river to 23 ft. of water. In its center there is a gate chamber 6 ft. sq., from which a wooden flume 3½ ft. in diam. conveys water, 1,964 ft. to a pump-well of stone in cement, 8 ft. in diam. by 32 ft. deep. The flume is of red pine staves, each 4 in. wide and thick, nailed every 4 in. with 3-in. copper nails. Every 4 ft. the flume is hooped with ½ by 3-in. iron, bolted on.

Pumping Machinery.—Dy. cap., not given. In '84 a Holly quadruplex pump was in use.

Distribution.—(In '84.) *Mains*, 12 to 4-in. c. i., 8½ miles. *Services*, lead. *Taps*, 1,100. *Meters*, 7. *Hydrants*, 14.

Consumption, 180,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 75 lbs.

Financial.—(In '84.) Cost, $125,000. Hydrant rental, $1,000 for 14, or about $70 each.

Management.—Not given. Address David Seath, 12 Place D'armes, Montreal.

NOTE:—Requests for information have been ignored since '84.

SAINTE HENRI, *L'Assomption Co.* (Pop., 700; in '83, 7,550.) A suburb of Montreal. Settled in '72; incorp. a city in '73.

History.—Built in '80 by Berger & Béique, without Contrs.

Water Supply.—Berger & Béique's system at Ste. Cunegonde.

Distribution.—(In '84.) *Mains*, c. i., 9½ miles. *Services*, lead. *Taps*, 1,550. *Meters*, 9. *Hydrants*, 32.

Consumption, 275,000 galls. *Pressure*: Ordinary, 50 lbs. Fire, 75 lbs.

Financial.—(For '84.) Cost, $112,000.

Management.—Not given. Address David Seath, 12 Place d'Armes, Montreal.

SAINT HYACINTHE, *Saint Hyacinthe Co.* (Pop., 5,321; est., 10,000.) On Yamaska river. Engaged in manufacturing.

History.—Built by St. Hyacinthe Water-Works Co., date not given.

Water Supply.—Yamaska river, by direct pumping.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; a Knowles and a Blake pump.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. *Taps*, 850. *Meters*, none. *Hydrants*, Chapman, 29.

Consumption, 285,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 70 lbs.

Financial.—Cost, $120,000. Capital stock, $50,000. Debt, not given. Int., 6%. Ann. op. exp., $4,500. Ann. rev.: consumers, withheld, but est., $10,000; city, $600.

Management.—Supt., M. A. Connell.

SAINT JOHN'S, *Saint John's Co.* (Pop., 4,314; est., 5,500.) On Richelieu river.

History.—Built in '72 by Louis Molleur's Sons. Contrs., Jno. McDougal, Montreal, and Beauchemin & Sons, Sorel.

Water Supply.—Richelieu river, pumping direct and to reservoir.

Pumping Machinery.—Dy. cap., 900,000 galls.; two 8½-in. duplex steam pumps of 17-in. stroke, and 7-in. water-power pumps. All furnished by Jno. McDougall, Montreal.

Reservoir.—Cap., 27,000 galls.; 24 ft. in diam. by 8 ft. deep.

Distribution.—*Mains*, c. i., 16 miles; imported from Glasgow, Scotland. *Services*, lead. *Taps*, 900. *Meters*, (in '85,) 12. *Hydrants*, 42.

Consumption, 500,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 100 lbs.

Financial.—Cost, $115,000. No debt. Ann. op. exp., $1,500. Ann. rev.: consumers, $9,500; city, none.

Management.—Owners, Louis Molleur's Sons. Supt., P. L. Henreuex. Engr., Pierre Laberge.

SHERBROOKE, *Sherbrooke Co.* (Pop., 7,227; est., 8,000.) At junction of Mogog and St. Francis rivers, which afford water-power. Has various manufactories.

History.—Built in '80-1 by Sherbrooke Gas & Water Co. Engr. and Contr., A. O. Granger.

Water Supply.—Magog river, pumping to reservoir. The river is the outlet of Lake Memphramagog.

Pumping Machinery.—Cap. not given; two 14-in. Knowles pumps of 16-in. stroke, driven by two 54-in. turbines working under an 8-ft. head.

Reservoir.—Cap., 3,000,000 galls.

Distribution.—*Mains*, c. i., 8 miles; imported from Glasgow, Scotland. *Services*, lead. *Taps*, 320. *Meters*, 3. *Hydrants*, kind not given, 50.

Consumption, 300,000 galls. *Pressure*: Ordinary, 70 lbs.

Financial.—The original cost of gas and water-works was $150,000. Capital stock, $200,000, including gas and water-works. Debt, not given. Ann. op. exp., not given, but est., $1,500. Ann. rev.: consumers, not given, but est., $3,500; city, $1,450. Hydrant rental, $29 each.

Management.—Prest., R. N. Hall. Secy., E. F. Waterhouse.

SOREL, *William Henry Co.* (Pop., 5,792; est., 7,500.) On St. Lawrence, at mouth of Richelieu river, on level ground. Settled in 1785; incorp. a city in '60.

History.—Built in '72-3 by town. Engrs., Beauchemin & Sons, Sorel.

Water Supply.—Richelieu river, by direct pumping.

Pumping Machinery.—Cap., not given. Water-power pumps are reported for '88, but the first two pumps were driven by steam, and had 12-in. steam and 8-in. water cylinders, while in '77 a Worthington duplex pump with 18-in. steam and 10-in. water cylinders was added. Some of the pumps were made by Beauchemin & Sons, Sorel.

Distribution.—*Mains*, c. i., w. i., 20 miles. *Services*, lead. *Taps*, 1,850. *Meters*, none. *Hydrants*, 42.

Consumption, 130,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 120 lbs.

Financial.—Cost, $100,000. Debt, $12,000. Int., not given. Ann. op. exp., $3,500. Ann. rev.: consumers, $9,500.

Management.—Prest. of Com., P. Beauchemin. Supt., I. Mour.

THREE RIVERS, *St. Maurice Co.* (Pop., 9,296; est., do.) At junction of St. Maurice and St. Lawrence rivers. Settled about 1620; incorp. a city in '57.

History.—Built by city in '75. Const. Engrs., P. N. Robichon and Henry Lor.

Water Supply.—St. Lawrence river, by direct pumping from a settling reservoir.

Filter.—Consists of 9 ft. of broken stone and coarse sand, through which water passes to reservoir.

Settling Reservoir.—In wharf. Water passes from this to pump-well through 120 ft. of 8-in. wrought-iron pipe.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; duplex pump of 12-in. steam, and 7-in. water cylinder of 24-in. stroke, made by Beauchemin & Sons, Sorel.

Distribution.—*Mains*, c. i., 15 miles; made in Scotland. *Services*, lead. *Taps*, 1,400. *Meters*, 3. *Hydrants*, 57.

Consumption, 250,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 130 lbs.

Financial.—Cost, $130,000. Debt, $115,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $14,000; city, $1,000.

Management.—Supt., O. Z. Hamel.

VALLEYFIELD, *Beauharnois Co.* (Pop., 4,000; est., 6,000.)

History.—Built in '86 by city. Engr., T. E. Vanier, Montreal. Contrs., Octave Cossette.

Water Supply.—St. Lawrence river, pumping direct.

Pumping Machinery.—Cap., 1,200,000 galls. Two Blake pumps. Turbines from J. C. Wilson, Pictou.

Distribution.—*Mains*, 10 to 4-in. c. i., 5 miles; from McFarlane, Strong & Co., Glasgow, Scotlond. *Services*, lead. *Taps*, 400. *Meters*, none. *Hydrants*, Chapman, 46. *Valves*, Chapman.

Pressure: Ordinary, 40 lbs. Fire, 100 lbs.

Financial.—Cost, $60,000. Debt, not given. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, about $7,000; city, not given.

Management.—Secy. and Treas. of corporation, R. S. Joron. Supt., Emmanuel May.

Water-Works Projected with Fair Prospects of Consruction.

LACHINE, *Montreal Co.* (Pop., 2,806; est., 3,500.)

Proposed System.—To be built by town in '89, at an estimated cost of $75,000. Water to be pumped from St. Lawrence river to a stand-pipe. Mayor, A. J. Dawes. Secy. and Treas. of corporation, H. Robert.

ONTARIO.

Water-Works Completed or in Process of Construction

AYLMER, *Ottawa, Co.* (Pop., 1,762; est., 2,337.) On Catfish creek. Has manufactories.

History.—Built for fire protection and lawn sprinkling in '84 by town. Engr., Alex. Milne, Aylmer. Labor done by the day.

Water Supply.—Catfish creek, by direct pumping.

Pumping Machinery.—A 700,000-gall. Worthington pump.

Distribution.—*Mains* c. i. 2.8 miles; from Alex. Gartshore, Hamilton. *Services*, w. i. *Hydrants*, 24. *Pressure*: Ordinary, 60 lbs. Fire, 100 lbs.

Financial.—Debt, $14,000. Cost, $14,000. Int., 5%. Ann. op. exp., $600. Ann. rev.: consumers, $400; city, none.

Management.—Engr. Alex. Milne.

BELLEVILLE, *Hastings Co.* (Pop., 9,516; est., 11,000.) On Bay of Quinte at mouth of Moira river. Has manufactories.

History.—Built in '87 by Moffett, Hodgkins & Clarke, Watertown, N. Y.

Water Supply.—Lake, filtered, pumping to tank.

Pumping Machinery and Tank.—Not described.

Distribution.—*Mains*, c. i., 15.3 miles. *Services*, galv. i. *Taps*, 103. *Meters*, none. *Hydrants*, kind not given, 169.

Consumption, 259,000,000 galls. *Pressure*: Ordinary, 70 lbs. Fire 150 lbs.

Financial.—Cost, $200,000. Debt, $100,000. Int., 6%. Ann. op. exp., withheld, but est., $5,000. Ann. rev.; consumers, withheld, but est., $2,500; city, $7,000. Hydrant rental, about $40.

Management.—Main offices, Watertown, N. Y. Supt., Geo. A. Pope.

BERLIN, *Waterloo Co.* (Pop., 4,800; est., 7,500. Engaged in various manufactories.

History.—Built in '88 by Moffett, Hodgkins & Clarke, Watertown, N. Y. Const. Engr., C. T. Taylor.

Water Supply.—Springs, pumping to stand-pipe from brick pump-well; connection can also be made with the lake in case of emergency.

Pumping Machinery.—Dy. Cap., 2,000,000 galls. Two Worthington pumps; two steel tubular boilers, 14 by 5 ft.

Stand-Pipe.—Cap., $156,000 galls.; 16 by 104 ft., on an elevation of 94 ft.

Distribution.—*Mains*, c. i., about 9 miles *Hydrants*, 65.

Financial.—Hydrant rental, $50 each.

Management—Berlin Water-Works Co.

BROMPTON, *Peel Co.* (Pop., 1,920; est., 2,500.) On Etobicoke river, on slightly undulating ground. Has some manufactories. Settled in '37; incorp. a town in '73.

History.—Built in '81-2 by town. Des. Engr., Louis H. Knapp, or——Tracey, London. Const. Engr., Chas. G. Wheelock, Orangeville. Contrs., Stephens, Turner & Burns, London.

Water Supply.—Snell's lake, by gravity. The lake has an area of about 40 acres, a drainage area of 700 acres, is 4½ miles from, and 120 ft. above town.

Filter.—Water passes from lake to conduit through timber crib filled with gravel.

Supply Conduit.—Of 12-in. cast-iron, about 4½ miles long.

Distribution.—*Mains*, c. i., 4 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Meters*, none. *Hydrants*, kind not given, 60.

Consumption, 300,000 galls. *Pressure*: 50 lbs.

Financial.—Cost, $65,000. Bonded debt, $65,000. Int., 5%. Ann. op. exp., $200. Ann. rev., consumers, $3,600, of which $1,500 is from railways.

Management.—Not given. Report by Richard Blain.

BRANTFORD, *Brant Co.* (Pop., 9,626; est., 13,000.) On Grand river. Has manufactories. Settled about '30; incorp. a city in '76.

History.—Built in '69 70 by Brantford Water-Works Co., chiefly for fire protection. Des. Engr. C. H. Wilson.

Water Supply.—Spring creek, by direct pumping and pumping to tank. The point of supply is about a mile from town, and the water is partially filtered through gravel, and is not potable.

Pumping Machinery.—Dy. cap., 250,000 galls., a Worthington duplex and a high-pressure pump made by Waterous, of Brantford.

Tank.—Cap., 29,000 galls.; brick, 15 by 26 ft., by 10 ft. deep.

Distribution.—*Mains*, c. i., 7½ miles; chiefly from Alex. Gartshore, Hamilton. *Services*, w. i. *Taps*, 108. *Meters*, 12. *Hydrants*, kind not given, 96.

Consumption, 175,342 galls. *Pressure*: Ordinary, 63 lbs. Fire, 75 lbs.

Financial.—Cost, $60,961. Capital stock, $61,000. No debt. Ann. op. exp., $2,300. Ann. rev.: consumers, $4,800; city, $1,658, or 6% on total outlay for Co.'s plant.

Management.—Prest., Ignatius Cockshutt. Secy. and Supt., T. M. Shenston.

BROCKVILLE, *Leeds. Co.* (Pop., 7,608; est., 9,000.) On St. Lawrence river. Has manufactories.

History.—Built in '81-4 by Brockville Water Co. Des. Engr., H. F. Gaskill, Lockport N. Y. Contrs., J. B. A. Bèique began, and Tourville & Co. finished the works.

Water Supply.—St. Lawrence river, by direct pumping.

Intake.—A crib, 25 by 30 ft., by 42½ ft. deep, is located 425 ft. from low water mark, and from it a 16-in. suction pipe, with flexible joints, extends to the pump-well 8 ft. in diam. by 12 ft. deep. At the end of the suction pipe there is a screen of 1-in. iron bars and ¼-in. galvanized wire gauze.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; compound condensing Holly-Gaskill pump of 12-in. bore and 18-in. stroke.

Distribution.—*Mains*, c. i., 9 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Taps*, 400. *Meters*, 4. *Hydrants*, Chapman, 82. *Valves*, Chapman.

Consumption, 800,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 75 to 90 lbs.

Financial.—Cost, $185,000. Capital stock, $200,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., about $5,000. Ann. rev.: consumers, $9,050, including $3,050 from railroads; city, $4,000. Hydrant rental, about $50 each.

Management.—Prest., W. H. Cole. Mgr., Secy. and Treas., B. F. Steben.

COBOURG, *Northumberland Co.* (Pop., 4,957; est., 5,000.)

General Description.—In '88 the city made a contract with Moffett, Hodgkins & Clarke, Watertown, N. Y., for 6 miles of 12 to 4 in. cast-iron mains, and 60 hydrants. Water to be pumped from Lake Ontario to a stand-pipe 16 ft. in diam. and 104 ft. high; also direct in case of fire. The Cobourg Water-Works Co. has been organized and will be controlled by the above company. The works are to be completed in July, '89.

CORNWALL, *Stormont Co.* (Pop., 4,468; est., 5,000.) On St. Lawrence river. Manufactures cotton, woolen, and other goods.

History.—Built in '86 by Cornwall Water Co., under a 50 years' franchise. The works are controlled by Moffett, Hodgkins & Clarke, Watertown, N. Y., who were Contrs. Des. Engr., F. S. Pecke, Watertown, N. Y. Const. Engr., O. W. Weed. Consulting Engr., Willis Chipman, Brockville.

Water Supply.—St. Lawrence river, pumping to stand-pipe.

Pumping Machinery.—Worthington pump, dy. cap., not given.

Stand-Pipe.—Cap., about 230,000 galls.; of iron, from Sharon (Pa.) Boiler Works.

Distribution.—*Mains*, c. i., 7 miles. *Services*, galv. i. Pipe and specials from Alex. Gartshore, Hamilton. *Taps*, 119. *Meters*, 6. *Hydrants*, from Chas. Smith & Co., Toronto, 55. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Ordinary, 63 lbs. Fire, 150 lbs.

Financial.—Cost, $125 000. Debt, $80,000. Int., 6%. Ann. op. exp., withheld, but est., $2,500. Ann. rev.: consumers, withheld, but est., $3,000; city, $2,000. Hydrant rental, about $36.

Management.—Prest., J. V. Clarke. Secy., H. C. Hodgkins. Supt., Jas. Strickland.

DUNDAS, *Wentworth Co.* (Pop., 4,000; est., 3,000.) On Burlington bay, Lake Ontario. Engaged in manufacturing.

History.—Built in '83 by town. Engr., J. B. E. Hugh Fairgrieve, Hamilton.

Water Supply.—Springs, by gravity from receiving reservoir. The springs are on hills 560 ft. high, back of town.

Reservoir.—Cap., 1,250,000 galls. Built by town.

Distribution.—*Mains*, 12 to 6-in., material not given, 6 miles; from Stevens, Turner & Burns, London. *Taps* and *Meters*, not given. *Hydrants*, kind not given, about 40.

Consumption, not given. *Pressure*: 75 to 110 lbs.

Financial.—Cost, about $40,000. The sum of $100 a year is paid a "care-taker." Debt, int. and rev., not given.

Management.—Not given. Report by J. E. W. McFarlane.

GANANOQUE, *Leeds Co.* (Pop., 2,856; est., 3,500.)

General Description.—Built by town for fire protection. A Giant water-wheel drives a rotary pump, water being furnished free by the Gananoque Water Power Co., at one of their dams. *Mains*, 3-in. c. i., ½ mile. *Hydrants*, 14. *Pressure*: 90 lbs. Ann. op. exp., about $100.

Report by C. R. Cotton, Supt. of Power Co.

GODERICH, *Huron Co.* (Pop., 4,500; est., 5,000.) On shore of and 150 ft. above Lake Huron, on a level plateau.

History.—Built in '88 by city. Engr., Willis Chipman, Brockville. Contr., E. Sherman, Goderich.

Water Supply.—Artesian wells, and Lake Huron in case of emergency, pumping direct. There are 4 wells, each 8 in. in diam., by 250 ft. deep. Water from the wells rises 14 ft. above the surface, has a temperature of 49° Fahr., and is very pure.

Pumping Machinery.—Dy. cap., 2,000,000 galls.; one compound duplex pump, from Gordon Steam Pump Co., Hamilton, O. Boilers from Chrystal & Black, Goderich.

Distribution.—*Mains*, c. i., 8 miles. Pipe and specials from A. Gartshore, Hamilton. Trenching and pipe-laying done by Harding & Leathorn, London. *Hydrants*, from J. Currie & Co., London, 48. *Valves*, from J. Currie & Co.

Consumption, 200,000 galls. *Pressure*: Ordinary, 125 lbs. Fire, 175 lbs.

Financial.—Cost, $50,000.

Management.—City Council.

GUELPH, *Wellington Co.* (Pop., 10,000; est., 10,500.) On Speed river, on undulating ground rising 130 ft. above river. Has various manufactories. Settled in '27; incorp. a city in '79.

History.—Built in '79-80 by city. Des. Engrs., Thos. Inglis and F. W. Cooper. Const. Engr., Thos. Inglis. Contr. for masonry and buildings, Jno. Quinn.

Water Supply.—Springs and surface water, with a river connection for emergency, by direct pumping from reservoirs.

Reservoirs.—A T-shaped basin, excavated through gravel and clay to 10 ft. below the river surface receives water from springs and from infiltration. A 30-in. brick conduit leads from this to Speed river, and the suction pipe is so arranged that water can be drawn from either the basin or the river. About 250 ft. from this basin is a second, the plan having been to have the water filter through the gravel between the two, the pump-well being at the second.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; Blake and McKay pumps. The first pumps had 14-in. water, and 7-in. steam cylinders of 22-in. stroke, and were made by Inglis & Hunter, Guelph.

Distribution.—*Mains*, c. i., 16 miles. *Services*, lead. Pipe and specials from St. Lawrence Foundry, Toronto, and trenching and pipe-laying done by Jno. Wanless & Jno. Heuer. *Taps*, 500. *Meters*, 3. *Hydrants*, kind not given, 104.

Consumption, 500,000 galls. *Pressure*: Ordinary, 85 lbs. Fire, 120 lbs.

Financial.—Cost, $125,000. Debt, $80,000. Int., 6%. Ann. op. exp., $5,000. Ann. rev.: consumers, $7,000; city, $2,000.

Management.—Supt., Richard Mitchell.

HAMILTON, *Wentworth Co.* (Pop., 35,965; est., 45,000.) At head of Hamilton, or Burlington bay, Lake Ontario, on sloping ground extending from the bay to the foot of a hill, 1½ miles. The business part of the town is 70 ft. above the lake Settled in 1779, but as late as '30 had but 653 inhabitants.

History.—Built in '56-9 by city. Des. Engr., Thos. C. Keefer, Ottawa. Contr. for masonry and foundations, Isaiah Beer.

Water Supply.—Lake Ontario, pumping direct and to reservoir from a filter basin on a sand bar between the bay and the main lake. The reservoir receives and stores the surplus water pumped.

The water of the bay is unfit for use, as the city sewage and street drainage discharge into it, and also the drainage from large vegetable deposits in the Des Jardin Marsh. The soil at this point is red clay, and the lake water is reddened by the wash of the banks, and at times has fine sand in suspension.

Filter Basin.—Dredged in the sand and gravel beach, and originally having a depth of 6 ft. below the lake surface, and an area of 1½ acres; in '72 it was enlarged and deepened. In Oct., 79, continuous pumping for a week at the rate of 2,500,000 galls. a day lowered the water 2.6 ft. below lake level.

Pumping Machinery.—Dy. Cap., 13,000,000 galls.: The old machinery consists of two Simpson compound condensing vertical beam and fly-wheel engines, with bucket and plunger pumps, having vacuum vessel on the suction, and large cast-iron chamber on force mains. The high-pressure cylinders are 24-in. in and of 72-in. stroke; the low-pressure, are 42 in. in diam. and of 96-in. stroke. These pumps were made in about '59 by Alex Gartshore, Hamilton, while in '87-8 the Osborne, Kelly & Co. Hamilton, built horizontal compound condensing pumps. In '81 a small pump was also in use.

Force Mains.—Is 18 in. in diam., 6 miles long, and leads directly to the distributing system, with a branch to the reservoir through which surplus water passes.

Reservoir.—Cap., 11,000,000 Imp., or 13,190,000 U. S. galls.; midway between pumps and city, on mountain side. 185 ft. above lake.

Tank.—Used in '81 for a limited high service. Size not given.

Distribution.—*Mains*, c. i., 72 miles; from Alex. Gartshore, Hamilton. Trenching and pipe-laying, in '57-9, done by W. Kendrie, and now done by the day. *Services*, lead. *Taps*, 10,000. *Meters*, none. *Hydrants*, Ludlow, 575. *Valves*, Ludlow.

Consumption, 2,750,000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 75 lbs.

Financial.—Cost, $1,250,000. Bonded debt, $900,000. Int., 6%. Ann. op. exp., $26,000. Ann. rev.; consumers, $134,000; city, none.

To '60 the works cost $650,000. To Dec. 31, '80, the total expenditures had been $945,353, and the total receipts, $397,793. In '80 the op. exp., were $27,629, and the receipts, $99,729.

Management.—Mgr., and Supt., Wm. Haskins, the City Engr. Secy., W. Monk. Pumping Engr., Jas. McFarlane.

IROQUOIS, *Iroquois Co.* (Pop., 1,500; est., 1,200.)

History.—Built in '85-6 by R. H. Buchon & Gordon Serviss. Engr., Wm. Perry. Labor done by owners.

Water Supply.—St. Lawrence river, by direct pumping.

Pumping Machinery.—Not described.

Distribution.—*Mains*, c. i., 2 miles; imported from Scotland. *Services*, lead. *Taps*, (in '86,) 35. *Meters*, none. *Hydrants*, kind not given, 15.

Consumption, about 50,000. *Pressure*: Ordinary, 45 lbs. Fire, 75 lbs.

Financial.—Cost, $18,000. Capital stock, $18,000. No debt. Ann., op. exp., $450. Ann. rev.; consumers, withheld, but est., $800; city, (in '86) $1 550.

Management.—Supt., Gordon Serviss.

KINGSTON, *Frontenac Co.* (Pop., 14,093; est., 16,000.) At mouth of St. Lawrence river, on Lake Ontario. Has extensive manufactories.

History.—Now owned by city. Built in '50 by a company, and sold in '87 to city for $120,000. About $140,000 is being expended in '88 9 on extensions and reconstruction. See foot note. Engr. for new work, T. O. Bolyer, the City Engr. and Mgr.

Water Supply.—Lake Ontario, pumping to reservoir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.

Distribution.—*Mains*, c. i., 11 miles; from Alex. Gartshore, Hamilton. *Services*, lead. *Taps*, 1,200. *Meters*, (in '86,) 12. *Hydrants*, 45.

Consumption, 1,000,000 galls. *Pressure*: 20 to 40 lbs.

Financial.—Cost to company, to '86, $150,000. Purchase price paid by city, $120,000. Ann. op. exp., in '86, $10,000. Ann. rev.: consumers, in '86, $21,000.

Management.—City Engr. and Mgr., T. O. Bolver. Supt., T. Hewett.

NOTE:—The extensions and improvements consist of mechanical filters, a new pump, a 16-in. force main 2 miles long, a steel water tower 40 by 80 ft., 6 miles of 6, and 1 mile of 8-in. mains, and 100 hydrants.

LINDSAY, *Victoria Co.* (Pop., 5,081; est., 6,500.) On Scugog river.

History.—Built in '74 by town, for fire protection.

Water Supply.—Scugog river, by direct pumping.

Pumping Machinery.—Two Holly pumps driven by two 52-in. turbines working under 6½ to 8-ft. head, and No. 4 Worthington steam pump. The Holly pumps were made by Waterous, of Brantford.

Distribution.—*Mains*, 8-in. c. i., about 1 mile. *Hydrants*, 17.

Pressure: 110 lbs.

Financial.—Cost, about $15,000. Bonded debt, $10,000. Int., 6%. Ann. op. exp., about $1,600. No rev.

Management.—Not given. Report by Dr. Burrows.

LISTOWEL, *Perth Co.* (Pop., 2,684; est., 3,000.)

History.—Built for fire protection in '84 by town, Hess Bros. owning and operating the pumping machinery, in connection with their factory, for $500 a year.

Water Supply.—Stream, by direct pumping.

PumpingMachinery.—Two Northey pumps, one of 700,000 galls. cap., with 14-in. steam, and 8-in. water cylinders; one of 800,000 galls., with 16-in. steam, and 8-in. water cylinders. Both owned and operated by Hess Bros., in connection with a furniture factory.

Distribution.—*Mains*, 6 and 4-in., ½ mile. *Hydrants*, 6.

Financial.—Cost, to city, $6,000. No debt. Ann. op. exp., $500. No rev.

Management.—Chf. Fire Dept., Adam Hess. Town Clerk, Jno. W. Burgess.

LONDON, *Middlesex Co.* (Pop., 19,763; est., 35,000.) At junction of North and South branches of Thames river. Settled in '26.

History.—Built in '78 by city, when population was about 20,000. Des. Engrs., Robinson & Tracy. Const. Engr., Thos. H. Tracy, the present Supt. Principal Contrs., Stevens & Burns, London.

Water Supply.—Springs, about 4 miles from city, pumping to reservoir and direct.

Dam.—Across Thames, 350 ft. long, giving head to drive water-power pumps. Contr., J. Crouse.

Pumping Machinery.—Dy. cap., 2,000,000 Imp., or 2,400,000 U. S. galls.; two Worthington water-power pumps, driven by two 72-in. Risden turbines, under 12-ft. head, and horizontal compound condensing steam pumps made by Osborne, Kelly & Co., Hamilton.

Reservoir.—Cap., 7,000,000 galls.; formed by embankment across one side of natural depression. Inner slope is covered with 6 in. of tough puddled clay, overlaid with 6 in. of concrete made of hydraulic lime, and these layers topped with 2 ft. of puddled clay and 6 in. of gravel.

Supply Main.—The principal one is of 18-in. cast-iron, tested to 500 lbs. per sq. in. It crosses over the river twice, and under it once.

Distribution.—*Mains*, c. i., 50 miles; furnished by the Contrs. *Services*, lead. *Taps*, 4,000. *Meters*, 25. *Hydrants*, 270. Valves and hydrants from the Contrs., the hydrants being similar to the Mathews, and the large valves to the Eddy.

Consumption, 2,250,000 galls. *Pressure*: 80 lbs.

Financial.—Cost, $491,000. Debt, $400,000. Int., 6%. Ann. op. exp., $12,000. Ann. rev.: consumers, $37,000; city, $9,000. Hydrant rental, $25.

Management.—Secy., J. Burke. Supt., Thos. H. Tracy.

LOUISVILLE, *Bothwell Co.* (Pop., 100.)

General Description.—It is stated there are 3 miles of mains, 20 hydrants and a pressure of 75 to 100 lbs. Supt., R. Lambert.

No official report has been received.

MERRITTON, (Pop., est., 2,000.) Near Grand river and New Welland canal.

History.—Built in '88 by town. Engr., Thos. Monro, St. Catherines.

Water Supply.—Welland canal, by gravity to reservoir.

Reservoir.—Cap., 4,000,000 galls.; has an area of about 20 acres.

Distribution.—*Mains*, 14 to 8-in. c. i., 6 miles. *Hydrants*, 36. *Valves*, Eddy.
Pressure: 75 to 80 lbs.
Financial.—Cost, $74,322.
Management.—Chn. Water Com., Chas. Riordon.
NOTE:—No further information given.

MILTON, *Holton Co.* (Pop., est., 1,400.)
History.—Built in '87-8 by town. Engr., James A. Bell, St. Thomas. Contrs., McQuillan & Co., Toronto.
Water Supply.—Springs, by gravity to reservoir.
Reservoir.—Cap., 150,000 galls.
Distribution.—*Mains*, 8 in. *Hydrants*, 15.
Financial.—Cost, $18,400. Debt, $20,000. Int., 5%.
Management.—Town Council. Town Clerk, A. S. Nedham.
NOTE:—No further data.

MITCHELL, *Perth Co.* (Pop., 2,500; est., 2,300.) Has manufactories.
History.—Built for fire protection in '74 by town.
Water Supply.—Surface water, by direct pumping.
Pumping Machinery.—Cap., not given; two pumps of 16-in. cylinders, made by Inglis & Hunter.
Distribution.—*Mains*, 6 and 4-in. c. i., 6,500 ft. *Hydrants*, 10.
Pressure: not given.
Financial.—Cost, $15,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., about $900. No rev.
Management.—Chn. Com., Jas. Sills. Clerk, Robt. Christie.

MORRISBURG, *Dundas Co.* (Pop., 2,000.)
History.—Built in '87 by town. Engr., Wm. Kennedy, Owen Sound.
Water Supply.—St. Lawrence river, pumping direct.
Pumping Machinery.—*For domestic supply*: Dy. cap., 504,000 galls. One single-acting plunger pump with 3 pistons, each 7⅜ ins. in diam., 20-in stroke, working against 90 lbs. pressure in air vessel; driven by water wheel, 40 in. in diam.

For fire protection: cap., 1,440,000 galls. One Silsby rotary pump, working against 90 lbs. pressure in air vessel; driven by a water wheel, 61 in. in diam. Power is taken from St. Lawrence canal, which gives 8 to 10 ft. head. The water wheels can be shifted to operate either pump, or coupled together and run one or both. A duplex steam Blake pump, 14 in. cylinders, with a steel horizontal tubular boiler, 54 in. in diam. by 12 ft. long, has been provided for use when repairs are being made to canal.

Distribution.—*Mains*, material not given, 3 miles. Pipe and specials from Bellhouse, Dillon & Co., Montreal. Trenching and pipe-laying done by M. Ryan, Toronto. *Hydrants*, 22.

Pressure: Ordinary, 40 lbs. Fire, 120 lbs.

Financial.—Cost, $26,000. Debt, $26,000. Int., 5%. Ann. op. exp., about $400. Ann. rev.; consumers, not given; city none.
Management.—Town Council. Report by Wm. McKenzie.

NAPANEE, *Lenox Co.* (Pop., 3,681; est., 4,000.) On Napanee river.
History.—Built in '87-8 by J. P. Northey, Toronto. Engr., Jno. Gatt. Contr. for masonry, and foundations, Wm. Saul, Napanee.
Water Supply.—Napanee river, by direct pumping.
Pumping Machinery.—Dy. cap., 2,000,000 galls.; pumps driven by water-power, with an engine as reserve, all from the Northey Co., Toronto.
Distribution.—*Mains*, c. i., 2½ miles. *Services*, w. i. Pipe and specials from St. Lawrence Foundry, Toronto, and trenching, and pipe-laying done by F. F. Miller, Napanee. *Taps* and *Meters*, not determined. *Hydrants*, 40. The valves and hydrants are from Toronto Engine Works, the valves being of the Peet and the hydrants, the Mathew pattern.
Consumption, not determined. *Pressure*: Ordinary, 50 lbs. Fire, 100 lbs.
Financial.—Cost, $35,000. Debt and int., not given: Ann. op. exp., est., $1,500. Ann. rev.; consumers, not determined; city, $2,000. Hydrant rental, $50.
Management.—Owner, J. H. Northey, Toronto. Report by F. F. Miller.

NIAGARA FALLS, *Welland Co.* (Pop., 3,000; est., 3,800.) On Niagara river, below the Falls. Settled in '52; incorp. a town in '57.

History.—Now owned by town, having been bought in '84 from Niagara Water-Works Co. for $17,000. The works were built in '56 by Saml. Zimmermann, and the company organized later.

Water Supply.—Niagara river, by direct pumping, the surplus going to a reservoir.

Pumping Machinery.—Dy. cap., about 500,000 galls.; double-acting piston pump, driven by an 8-ft. over-shot water-wheel.

Force Main.—Of 6-in. cast-iron, 2 miles long.

Reservoirs.—Two, of 1,500,000 and 30,000 galls. cap., respectively. The first is lined with brick, and has broken twice. In '82 there was a stand-pipe at the end of the force-main in the large reservoir.

Distribution.—*Mains*, c. i., 11 miles. *Services*, w. i. *Taps*, 430. *Meters*, none. *Hydrants*, 4.

Consumption, about 500,000 galls. *Pressure*: at pump, 30 lbs.

Financial.—Cost, price paid by by city, in '84, $17,000. The est. cost, or value, is $30,000. Bonded debt, $14,000. Int., 5%. Ann. op. exp., for '86, $1,093. Ann. rev.: consumers, for '86, $2,902.

Management.—Supt., Edw. C. Carter.

NOTE:—In May, '88, Thos. Monro, St. Catharines, reported to the Water Comrs. on an additional supply. He recommended that a new pumping station be built, near the present one, if possible, with water-power pumps of at least 2,000,000 galls. cap. Water for power and supply would be brought from Niagara river to the pumps, through a tunnel about 5 ft. in diam. and 1,000 ft. long. The force main would be 14 in. in diam., and would lead to a reservoir of from 2,000,000 to 3,500,000 galls. cap. A 10-in. branch main of 3,000 ft. long, could be laid to supply a part of Drummondville. The est. cost of the new works is $97,500, or without the reservoir, $77,500.

ORANGEVILLE, *Wellington Co.* (Pop., est., 4,000.) Near Credit river.

History.—Built for fire protection in '76 by town.

Water Supply.—Credit river, pumping to reservoir and direct.

Pumping Machinery.—Two Holly rotary pumps.

Reservoir.—Cap., 110,000 galls.; 25 by 50 ft. by 12 ft. deep.

Distribution.—*Mains*, c. i., 1 mile. *Hydrants*, 10.

Pressure: 50 to 110 lbs.

Financial.—Cost, about $10,000. Debt, $10,000. Int., 6%. Ann. op. exp., $1,000. No rev.

Management.—Supt., Dr. Carbet. Pumping Engr., Thos, Robinson.

OTTAWA, *Carleton Co.* (Pop., 27,417; est., 36,000.) At junction of Ottawa and Rideau rivers.

History.—Built in '72-4 by city. Engr., Thos. C. Keefer, Ottawa. Contrs. for masonry and foundations, Ryan & Booth; for buildings, B. Gibson.

Water Supply.—Ottawa river, by direct pumping, water for power being conveyed through an open canal to the pump-house, and for consumption, through a wooden conduit laid in the bottom of the canal.

The point of supply is above Chaudiere Falls, at a point where the river has a strong current and a rocky bed. The falls are from 25 ft. high at low water to 35 ft. at high water.

For over 100 miles above the city the river is a succession of large, deep lakes, and rapids.

Canal.—Is 2,500 ft. long, cut through solid rock, with an average depth of 16, and width of 20 ft., giving a depth of 13 ft. below low water at head level. The entrance to the canal is formed by two lines of stone-filled timber crib-work, each 20 ft. wide by about 200 ft. long, and 25 ft. deep at the river end, placed 60 ft. apart. Booms protect the head of the entrance, and a rack with double stop-gates is built about midway in their length. Each gate has a 20 ft. opening, with grooves for receiving the logs forming the stop-gates. The gates are separated by a central pier containing a well with screens, from which the domestic supply conduit is fed. A second stop-gate is located down the canal. At the pump house the canal is stopped by curved dam, and a waste weir, both of masonry, carried above flood level.

On each side of the canal the rock is cleaned off for several feet, and the drainage is conducted from the canal. One railway and four roadway bridges cross the canal, all of stone. No provision was made for emptying or cleaning the canal.

Wooden Conduit.—Has an internal diam. of 30 in., and is of 2-in. pine staves, hooped every 4 ft. with ⅝ by 3-in. iron; except at anchorage points, where the hoops are of ⅝-in. iron. The conduit is laid in a trench, 3 by 1-ft., dug in the bottom of the canal. At every 12 ft. the conduit is anchored to the rock bed by 1-in. iron eye bolts, a hole first being driven in the rock, and soft pine trenail, with a diam. ¼-in. less than the drill-hole inserted, and the bolt driven home. Through this a lifting strain of 2½ tons was applied to each bolt, but none stirred.

Changes in the direction of the wooden conduit are made by cast-iron angle joints. This conduit cost $3.00 a foot, against $9.15, the price at that time for suitable iron pipe.

Pumping Machinery—Dy. cap., 6,000.000 galls.; three 2,000,000 gall. sets of single-acting water-power pumps, driven by 61-in. double Leffel turbines. The first two sets were furnished by the Jos. Hall Mfg. Co., and the third by the Victoria Foundry, (N. S. Blaisdell & Co.) Ottawa. Contracts were let in '88 to the Canadian Locomotive & Engine Co., Ltd., Kingston, for a 10,000,000-gall. set of pumps.

Distribution.—*Mains*, 58.7 miles; about two-thirds of the pipe used to the end of '75 was imported from Scotland, and the remainder furnished by R. D. Wood & Co., Philadelphia, Pa. To the end of '75 there had burst 66 lengths of Scotch to 7 of American pipe. The Scotch pipe had turned and bored joints, the American bell and socket, leaded, and to the end of '75 on 32 joints the Scotch pipe had leaked, to 25 on the American. *Services*, lead. *Taps*, 7,181. *Meters*, 12. *Hydrants*, Mathews, 413. *Pressure-recording gauge*, Edson.

Consumption, 3,736,000 galls. *Pressure*: Ordinary, 90 lbs. Fire, 110. lbs.

Financial.—Cost. $1,200,939. Bonded debt, $1,000,000. Int., 5%. Ann. op. exp., $50,456. Ann. rev. consumers, $119,294.

Management.—Com. of six Aldermen. Mgr., Robt. Surtees. Collector, Edw. Pinard. Treas., Thos. H. Kirby.

NOTE.—A detailed description of these works, as originally constructed, with itemized cost, is given in *Engineering News*, Vol. v., pp., 51, 62, 75 and 90.

OWEN SOUND, *Grey Co.* (Pop., 4,426; est., 6,600.

History.—Built in '80 by Parker & Nother; known as Owen Sound Water-Works Co. Des. Engr., Jno. Kennedy, Owen Sound. Labor done by the day.

Water Supply.—Springs, 2½ miles from, and about 170 ft. above town, by gravity.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 12 miles. *Services*, lead, iron. Pipe and specials from Don Foundry, Toronto. *Taps*, 200. *Meters*, 8. *Hydrants*, "Ottawa patent," 28.

Consumption, 50,000 galls. *Pressure*: 70 lbs.

Financial.—Cost, $60,000. No debt. Ann. op. exp., $1,200. Ann. rev.: consumers withheld, but est., $2,500; city, $1,400. Hydrant rental, $50 each.

Management.—Mgr., L. J. Parker.

PAISLEY, *Bruce Co.* (Pop., 1,350.)

NOTE:—Has works, but no description can be obtained. Chn. Water Com., James Claxton. Town Clerk, N. M. Kechine.

PARIS, *Brant Co.* (Pop., 3,300; est., 3,700.) In a valley, between Grand river and Smith's creek. Incorp. a village in '50; a town in '56.

History.—Built in '83-4 by town. Des. Engr., A. Ware. Const. Engr., J. A. Bell. St. Thomas, and W. Lavery. Contrs., J. J. Blackmore & Co., Paris. Sub-contrs. for masonry, J. Carnie & Son; for buildings, Turnbull & Thomson; both of Paris.

Water Supply.—Spring on Smith's creek, 1 mile from town, pumping to reser-

Pumping Machinery.—A 722,000-gall. duplex, and a 361,000-gall. single pump, both made by Northey & Co., Toronto.

Reservoir.— Cap., 1,250,000 galls.; 100 ft. sq. at bottom, 136 ft. sq. at top, 12 ft. deep, and 140 ft. above lower part of town.

Distribution.—*Mains*, c. i., 4 miles. *Services*, lead. Pipe and specials from Alex. Gartshore, Hamilton. *Taps*, about 250. *Meters*, none. *Hydrants*, kind not given, 25.

Consumption, not given. *Pressure*: 40 to 200 lbs.

Financial.—Cost, $40,000. Debt, $38,000. Int., 6%. Ann. op. exp., $1,200. Ann. rev.: consumers, $2,500; city, $1,200. Hydrants free.

Management.— Town Clerk, S. Dodson.

PARKDALE, (Pop., est., 5,400.) On Humber bay, Lake Ontario, on gently sloping ground. Incorp. a village in '79.

History.—Built in '81-2 by town; put in operation in March. Contr. for masonry and buildings, —— Coatsworth.

Water Supply.—Lake Ontario, by direct pumping.

Intakes.—The first crib is double, 40 ft. sq. outside and 20 ft. sq. inside, of 12-in timbers, the intervening 8 ft. filled with gravel. It is located in 18 ft. of water, '87 ft. from the shore. From the well of the crib a 12-in. cast-iron suction pipe, 687 ft. long, leads to the pump house; from the crib to the shore its joints are flexible. In '88 a 16-in. intake was laid into the lake for 1,500 ft., to 30 ft. of water.

Pumping Machinery.—Dy. cap., 3,800,000 Imp., or 4,555,000 U. S. galls.; high-pressure crank and fly-wheel pumping engines, a 2,500,000 Imp. gall. pump made by Chas. Smith & Co., and a 1,300,000 Imp. gall. Walker pump.

Distribution.—*Mains*, c. i., 12⅛ miles; from McQuillan & Co. *Services*, lead, iron. *Taps*, 1034. *Meters*, Worthington, Crown and Kennedy, 9. *Hydrants*, Mathews, 94.

Consumption, 370,000 Imp., or 443,000 U. S. galls. *Pressure*: Ordinary, 90 lbs. Fire, 110 lbs.

Financial.—Cost, $120,000. Debt, $120,000. Int., 5 and 6%. Ann. op. exp., $7,213. Ann. rev.: consumers, $8,502; city, $470. Hydrant rental, city allows Water Dept. $5, each.

Management.—Chn. Com., Ben. J. Goodman. Town Clerk and Treas., Alex. McMillan. Engr. and Supt., Jno. Patrick.

PETERBOROUGH, *Peterborough Co.* (Pop., 6 815; est., 9,000.) On Otonabee river, which falls 50 ft. in passing through the town. Engaged in manufacturing and lumber trade.

History.—Built in '82, and put in operation in Jan., '83, by Peterborough Water Co. The hydrant contract is for 10 years. Des. Engr., Robt. Surtees, Ottawa. Const. Engr., J. E. Belcher. Labor done by local contrs.

Water Supply.—Otonabee river, by direct pumping.

Dam.—Not described.

Filter.—Of charcoal and gravel.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two double-acting Knowles 14-in. pumps of 16-in. stroke, driven by two 33-in. Little Giant water-wheels, under 12-ft. head and fall.

Distribution.—*Mains*, c. i., 8½ miles; from Laidlaw & Son, Glasgow, Scotland, and Alex. Gartshore, Hamilton. *Services*, lead. *Taps*, 400. *Meters*, 4. *Hydrants*, 65. Valves and hydrants from Ludlow Valve Co., Troy, N. Y., and A. Doig, Toronto.

Consumption, 500,000 galls. *Pressure*: Ordinary, 75 lbs. Fire, 110 lbs.

Financial.—Cost, $90,000. Debt, $65,000. Int., 6%. Ann. op. exp., $8,500. Ann. rev.: consumers, $5,500; city, $3,100. Hydrant rental, $50 each.

Management.—Prest., Jno. Burnham. Supt., Wilson Henderson.

PORT HOPE, *Durham Co.* (Pop., 5,588; est., 5,720.) On Lake Ontario, at mouth of Smith's creek. The business part of the town is in the valley, and the residence sections on the hills. Settled in 1793; incorp. a town in '50.

History.—Built for fire protection in '74 by town. Engr. and Contr., Jno. Helm, Jr., Port Hope.

Water Supply.—Smith's creek, by direct pumping from mill-pond.

Pumping Machinery.—Cap. not given; rotary pump made by Wm. Hamilton.

Distribution.—*Mains*, 10 to 6-in. c. i., about 2 miles. *Hydrants*, kind not given, 27.

Pressure: 250 to 120 lbs.

Financial.—Cost, $8,000. No debt. Ann. op. exp., $200. No rev.

Management.—Supt., Jno. Gamble.

SAINT CATHARINES, *Lincoln Co.* (Pop., 9,642; est., 11,000.) Engaged in manufacturing.

History.—Built in '76-7 by city. Des. Engrs., Thos. Monro, and Louis H. Knapp; the latter is of Buffalo, N. Y., and was also Const. Engr. Contrs., Ferguson, Mitchell & Co.

Water Supply.—Beaver Dam creek, by gravity from impounding and storage reservoirs.

Reservoirs.—Cover about 43 acres, one having an area of 10, and the other of 33 acres. A large number of trees have been planted around one of the reservoirs.

Distribution.—*Mains*, 30 to 4-in. c. i., 20½ miles; from Yale & Co., St. Catharines, and Alex. Gartshore, Hamilton. *Taps*, 1,151. *Meters*, 6. *Hydrants*, Burow & Chatfield, 155. *Valves*, Eddy.

Consumption, about 500,000 galls. *Pressure*: 75 lbs.

Financial.—Cost, about $.75,000. Bonded debt, $275,000. Int., 6%. Ann. op. exp., $2,995. Ann. rev.: consumers, $8,050; city, none.

Management.—Chn., L. S. Oille. Supt., J. Albert Mills.

SAINT JEROME, *Rimouski Co.* (Pop., est., 3,200.)

History.—Built in '76 by town. Const. Engr., Evangeliste Dupras. Contr., Jos. LaChapelle, St. Jerome.

Water Supply.—Spring, by gravity.

Distribution.—*Mains*, wood, about 15 miles. *Services*, wood.

Financial.—Cost, about $15,000. Ann. op. exp., $350. Ann. rev.: total, about $4,200.

Management.—Supt., G. Lavilette.

NOTE:—No further information given.

SAINT THOMAS, *Elgin Co.* (Pop., 9,500; est., 10,300.) On Kettle creek, 7 miles from Lake Erie, in very uneven country. Engaged in manufacturing. Incorp. a city in '81.

History.—Built in '74 by town.

Water Supply.—Kettle creek, by direct pumping from impounding reservoir.

Dam and Reservoirs.—Not described.

Pumping Machinery.—Dy. cap., 600,000 galls.: two horizontal pumping engines make not given, and a Worthington pump. Two boilers.

Distribution.—*Mains*, c. i. 5 miles. *Services*, w. i. *Taps*, 290. *Meters*, 4. *Hydrants*, Holly, 56. *Valves*, Ludlow.

Consumption, about 300,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, 83 lbs.

Financial.—Cost, $70,000. No debt reported. An. op. exp., $4,132. Ann. rev.: consumers, $2,400; city, none.

Management.—Mgr., Jas. A. Bell.

SARNIA, *Lambton Co.* (Pop., 5,000; est., 5 800.) On St. Clair river, 2 miles below the foot of Lake Huron. Settled in '30; incorp. a town in '57.

History.—Built in '75-6 by town. No Des. Engr. Const., Engr., Robt. Turner, the present Supt. Labor done by local contrs., and by the day.

Water Supply.—St. Clair river, by direct pumping.

Intake.—A 20-in. iron pipe, 200 ft. long.

Pumping Machinery.—Dy. cap., 3,400,000 galls.; four Walker pumps, driven by high-pressure horizontal engines.

Distribution.—*Mains*, c. i., w. i., 14½ miles; from R. D. Wood & Co., Philadelphia, Pa., for construction; for extensions, from A. Gartshore, Hamilton, and T. T. Turnbull. *Services*, lead. *Taps*, 943. *Meters*, 4. *Hydrants*, Mathews, 100. *Valves*, Ludlow.

Consumption, 500,000 galls. *Pressure*: Ordinary, 35 lbs. Fire, 80 to 120 lbs.

Financial.—Cost, $70,000. Debt, $18,000. Int. 5%. Ann. op. exp., $4,015. Ann. rev.: consumers, $8,500; city, none.

Management.—Engr., and Supt., Robt., Turner. Inspector, Jas. Milne.

SEAFORTH, *Huron Co.* (Pop., 2,600; est., 3,000.) Engaged in manufacturing.

History.—Built for fire protection and lawn sprinkling in '79-80 by town. Engrs. and Contrs., Inglis & Hunter, Toronto, who furnished all material. Sub-contr. for masonry and buildings, Wm. Copp; for reservoir, Jas. Walsh & Wm. Sherrill.

Water Supply—Spring creek, by direct pumping.

Reservoirs.—Two; one 50 by 80ft., by 5½ ft., deep with a cap. of about 144,000 galls., one 20 by 50 ft., by 5½ ft., deep, with a cap. of about 38,000. galls.

Distribution.—*Mains*, c. i., 1¾ miles. *Hydrants*, 13.

Financial.—Cost, $11,000. Debt, 5,550. Int., 6%. Ann. op. exp., $465. Ann. rev.: consumers, $450.

Management.—Chn. Com., T. W. Duncan. Chf. Fire Dept., Jas. R. Wright.

SHELBURNE, *Grey Co.* (Pop., est., 1,300.) Engaged in manufacturing.

General Description.—Built in '88 9 by village. Contrs., Ontario Pump Co., Toronto. Water is pumped from well to tank. Halladay windmill drives a Curtis pump, of 25,000 galls. cap.

Tank.—Cap., 190,000 galls.; of wood. Is 20 by 30 ft., at an elevation of 1000 ft. *Mains*, 8 in., ¼ mile. *Hydrants*, kind not given, 7. Cost, $800. Report by F. G. Dunbar, City Clerk.

SMITH'S FALLS, *Lanark Co.* (Pop., 2,087; est., 4,000.) On Rideau canal. Engaged in manufacturing.

History.—Built in '87 by A. Foster. Engr., —— Henderson, Smith Falls. Contr., Geo. Dana, Brockville.

Water Supply.—Rideau river, pumping to tank.

Pumping Machinery.—Cap., 750,000 galls. One water-power pump, 10 by 12 in. cylinders, from Northey & Co. Toronto, and one duplex steam pump.

Tank.—Cap., 40,000 galls. At an elevation of 120 ft.

Distribution.—*Mains*, 6 in. c. i., 3 miles. *Services*, w. i. *Taps*, 100. *Meters*, none. *Hydrants*, Beckett, 4. *Valves*, Beckett.

Consumption, 45,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $20,000. No debt. Ann. op. exp., $400. Ann. rev.: consumers, $1,300; city, $200.

Management.—Owner, A. Foster.

STRATFORD, *Perth Co.* (Pop., 9,000; est., do.) On irregular ground on River Avon. Settled in '34; incorp. a town in '58.

History.—Built in '83 by Stratford Water Supply Co. Engr., Jno. M. Moore, London. Contr. for masonry and buildings, Wm. Roberts, Stratford.

Water Supply.—River Avon, by direct pumping.

Dam.—Of stone; not stated whether this was constructed for water-works.

Filter and Receiving Basin.—Above the dam 20 trenches, 10 to 12 ft. deep, were dug in the bed of the stream, and filled with coarse gravel. These lead to a covered basin of oak plank, 10 by 20 ft., from which a 12-in. pipe conveys water to the pump-well.

Pumping Machinery—A 2,500,000 gall. Worthington compound duplex pump.

Distribution.—*Mains*, c. i., 9½ miles. *Services*, lead. Pipe and specials, valves and hydrants from, and trenching and pipe-laying done by, Cakus & Drummond, London. *Taps*, withheld. *Meters*, 1. *Hydrants*, 76.

Consumption, 500 000 galls. *Pressure*: Ordinary, 60 lbs. Fire, 80 lbs, and more.

Financial.—Cost, $75,000. Capital stock, $75,000. Bonded debt, $40,000. Int., 5%. Ann. op. exp., $4,583. Ann. rev.: consumers, $5,976; city, $3,780. Hydrant rental, $40 each.

Management.—Prest., Jno. Corrie. Mgr., Thos. Clark. Secy. and Treas., D. B. Burritt.

TILBURY CENTRE, *Kent Co.* (Pop., est., 1,000 to 1,300.)

History.—Built in '88 by town. Engr., Jas. A. Bell, St. Thomas. Contrs., J. Currie & Co., London.

Water Supply.—Lake St. Clair, pumping direct. Water is conveyed from lake through an artificial channel, 1½ miles thence by 12-in. pipe to pump house.

Pumping Machinery.—Cap., 750,000 galls. One duplex pump from Hughes Bros., Cleveland, O.

Distribution.—*Mains*, c. i., 1½ miles. *Services*, w. i. *Taps*, not given. *Meters*, none. *Hydrants*, Mathews, 9. *Valves*, Ludlow.

Pressure: Ordinary, 30 lbs. Fire, 80 lbs.

Financial.—Cost, $12,000. Debt, $12,000. Int., 5%.

Management.—Manager, J. S. Richardson, Supt., Jas. A. Bell.

TILSONBURG, *Oxford Co.* (Pop., 2,000; est., 2,600.) Has manufactories.

History.—Built for fire protection in '75 by village.

Water Supply.—Surface water, by direct pumping.

Pumping Machinery.—Cap., not given; two rotary pumps, driven by a turbine water-wheel, under 28-ft. head.

Distribution.— *Mains*, 8 to 4-in. iron, 1.9 miles. *Hydrants*, Holly, 24.

Pressure: 100 lbs.

Financial.—Cost, $28,000. Debt, $19,000. Int., 6%. Ann. op. exp., $600. No rev.

Management. — Engr., P. McFarlane. Report by W. McDonald, Chf. Fire Dept.

TORONTO, *York Co.* (Pop., 86,415; est., 126,000.) On Lake Ontario, on a plain rising gently from the lake for about 2 miles, and then rising more abruptly to a range of hills. Settled in 1794 as York; name changed to Toronto in 1799.

WORKS FROM '41 TO THEIR PURCHASE BY CITY IN '73.

General Description.—Built in '41, when population was about 20,000, by —— Furniss. A 21 years' contract was made with the city for fire protection. Water was pumped from the lake, at a point opposite the city, to a stand-pipe and to St. George's and Cover Hill reservoirs. The first pumping machinery consisted of an engine with a 24-in. cylinder of 54-in. stroke, driving two single-acting pumps of 8-in. bore and 72-in. stroke.

In '51 the works were sold to a company, but they soon reverted to Mr. Furniss.

In '56-7 a pumping engine was added, with 32-in. steam, and 24-in. water cylinder, both of 72-in. stroke. To this time the works had cost about $160,000, and were paying a good dividend.

In '70 a compound engine was built, with 22 and 38-in. cylinders of 48-in. stroke, and driving a bucket and plunger pump of 27¼-in. diam. and 48-in. stroke.

In '73 the city bought the works for $200,000. There were then 20.77 miles of pipe, 7 miles being wrought-iron and cement, and the rest cast-iron.

PRESENT WORKS.

History.—Built in '73-8 by city, retaining parts of the old works. Construction was in charge of a special commission, of which Peter Alexander Peterson was Chf. Engr., and Thos. C. Keefer, E. S. Chesbrough and John Kennedy, Consulting Engrs.

Water Supply.—Lake Ontario, pumping to reservoir.

Old Filter Basin.—*Not in use.* The supply was originally drawn from a filter basin excavated in the shore of a sandy island, about 7,000 ft. from the city wharf line. The basin was 155 ft. from the shore line, 2,700 ft. long, 24 ft. wide at the bottom, which was 13½ ft. below low water in the lake. At the north end of the basin was an arm, 390 ft. long, 30 ft. wide at bottom, with slopes of 2 to 1.

In '76 the dy. rate of infiltration into the basin was 4,413,000 U. S. galls., or 1,420 galls. to 1 lin. ft., the difference of water level in the lake and gallery being 7½ ft.

The dy. consumption being 5,000,000 galls., it was necessary to make direct connection with the lake, by means of two cuts through the bank of the basin. The first cut was dredged 12 ft. below water level, was 20 ft. wide at bottom, had slopes of 2 to 1, and extended 300 ft. into the lake. It was filled from 6 to 9 ft. in depth with flat stones, and 6-in. cobble stones, above which was from 12 to 18-in. of gravel, then the sand which had been removed in excavating the cut.

In the second cut a wooden conduit was laid, extending 345 ft. into the lake to a crib 20 ft. sq., of 12-in. timbers spaced 4 in apart, and built in nine compartments, eight of which were filled with stone, and the ninth left open for a well. The wooden conduit had an internal diam. of 4 ft., and was constructed similarly to the original 4-ft. conduit leading from the basin towards the city, described below. From the lake side of the crib a perforated pipe extended 50 ft. into the lake.

When these two cuts were finished a test showed that the basin had a dy. cap. of 12,000,000 galls.

In '78 the cuts were twice filled with sand, cutting off the supply; in Feb., '79, they were useless, and a third cut was made to the lake, and a box conduit laid, which soon filled with sand.

An open cut was then tried, but as this also filled with sand, further attempts in this line were abandoned, and an extension of the conduit leading from the basin to the city was made into the lake, beyond the island. This extension was doubly necessary on account of the quality of the water in the filter basin, a large part of which was evidently from the marsh land on the island.

Present Intake.—Includes the old intake conduit from the filter basin to the pump-well, and the extension to a new intake crib.

Old Part of Intake.—Of wood, from the north arm of the filter basin for 6,000 ft. across Block House bay to Gibraltar point, where a crib forms a connection with a cast-iron pipe, leading to the pump-well.

The wooden conduit has an internal diam. of 4 ft., and is constructed of alternate staves of green oak and pine, each 3-in. thick, 6 in. wide and 16 ft. long, bound every two feet with iron hoops 3 in. wide. The first 1,400 ft. was sunk continuously.

a scow and sloping framework being drawn forward from under it as it was built. The trench could not be kept clear of sand, and the conduit had to be relaid, 200-ft. sections being adopted for this and the remaining distance. The 200-ft. sections were joined with iron flanges, bolted by divers.

Part of the wooden conduit was not properly covered with sand, and in Dec., '75, when pumping through it began, it rose to the surface. It was taken up, the trench dredged, and the conduit relaid, and covered with 2½ ft. of sand, since which it has remained in place.

This part of the conduit terminates in a crib at Gibraltar point, and when the conduit floated an opening was made in the crib, and the water admitted to it, and thus to and through the 36-in. submerged cast-iron pipe, with Ward's flexible joints, leading from 4,444 ft. to a crib 700 ft. from the esplanade along the city harbor front.

From the latter crib 200 ft. of iron pipe conveys water to the pump-well, which is 200 ft. from the esplanade, and has its foundation, carried to rock, 6 to 9 ft. below water surface.

Intake Extension.—The new conduit is 2,357½ ft. long, leading from the outer end of the old conduit to a crib in 26 to 30 ft. of water. The crib is 40 ft. sq., has double walls of 12-in. timbers, bolted with 1¼-in. iron, and a compartment 10 ft. sq. in the center, into which the conduit opens. The conduit has an internal diam. of 6 ft., is of 6 by 5-in. oak staves in sections, banded every 2 ft. with welded wrought-iron hoops ⅜ in. thick, and 3 in. wide. The staves have an average length of 14½ ft., and the butt joints are completed by 3-16 by 1-in. iron tongues let into the ends of the staves. The sections were 100 ft. long, after 200 ft. lengths proved unwieldly. The sections were joined by flanged castings, fastened by ⅝-in. bolts, the joints packed with wood. When not sufficiently loaded with a covering of sand there were placed every 100 ft. stone-filled cribs 22 ft. sq., similar in construction to large intake crib.

The average cost of building and placing the 100-ft. sections of the 6-ft. conduit, including the loading cribs, was $64.24; and of the 200-ft. sections, without cribs, $37.93 per 100 ft.

Pumping Machinery.—Dy. cap., 25,000,000 U. S. galls.; a 5,000,000-gall. pump erected in '74, and a 10,000,000-gall. pump erected in '76, both Worthington compound, and a 5,000,000-gall. Martin pump, made by Inglis & Hunter. Return tubular boilers are used.

Reservoir.—Cap., 40,168,320 U. S. galls.; in excavation and embankment, the bottom and slopes covered with 6 in. of broken stone overlaid with 12 in. of gravel. The inlet pipe is laid beneath the embankment, and at the foot of the inner slope is turned up for 2 ft., with a bell-mouth. It was laid in puddle, with three brick masonry collars, 1-ft. thick, projecting 1 ft. Slides occurred on the outer slopes previous to '78, but they were checked by under drainage.

Distribution.—*Mains*, c. i., w. i. and cement, 145¾ miles; only c. i. pipe has been laid since the new works were built, and no pipe less than 6 in. is now laid. *Services*, lead, galv. i. *Taps*, 25,535. *Meters*, 370. *Hydrants*, Mathews, 1,682. *Valves*, "department design."

Consumption, (for '86,) 11,344,337 U. S. galls. *Pressure*: 80 to 85 lbs.

Jan. 1, '80, there were 111.29 miles of mains, 8,563 taps, 49 meters, 47 hydraulic elevators and 1,070 fire hydrants. The consumption in '70 was 1,500,000, galls. and in '79, 4,660,000 U. S. galls.

Financial.—Cost, $2,643,000. Debt, $2,643,000. Int., 4, 5 and 6%. Ann. op. exp., $138,959. Exp. in '87 for int. and sinking fund, $163,337. Ann. rev.: consumers, $292,158; city, $66,473. Hydrant rental, $30 each.

Management.—Supt., W. Hamilton. Secy., Chas. Mathews. Pumping Engr., J. C. Ferguson.

TRENTON, *Northumberland Co.* (Pop., 2,300; est., 5,000.) On Trent river, at head of Bay of Quinte.

General Description.—Owned by Hugh O'Rourke. Water is conveyed from springs by gravity through wooden pipes laid in the principal streets. At frequent intervals small tanks or casks, are set in the ground, from which the water is continually running. Address Hugh O'Rourke.

UXBRIDGE, *Ontario Co.* (Pop., est., 1,800.) Has manufactories.

History.—Built for fire protection in '74 by town. Const. Engr., W. Wilson, Uxbridge.

Water Supply.—Creek, by direct pumping.

Pumping Machinery.—Rotary Waterous pump, cap. not given.

Distribution.—*Mains*, c. i., 3 miles. *Hydrants*, kind not given, 14.

Pressure: 140 lbs.

Financial.—Cost, $15,000. No debt. Ann. op. exp., $300.

Management.—Engr., W. McGuire.

WELLAND, *Welland Co.* (Pop., 1,870; est., 2,500.) On Welland river and canal. Has water-power.

History.—Built in '88 by town. Engr., Wm. Kennedy, Owen Sound.

Water Supply.—Welland canal, pumping direct.

Pumping Machinery.—Cap., 2,500,000 galls. Two duplex water-power pumps.

Distribution.—*Mains*, c. i., 3½ miles. *Hydrants*, 28.

Pressure: Ordinary, 60 lbs. Fire, 150 lbs.

Financial.—Cost, $32,000. Debt, $32,000. Int., 5%.

Management.—Water Com. Chn., D. Ross. Secy., and report by, J. F. Gross.

NOTE:—No further information given.

WIARTON, *Bruce Co.* (Pop., 916; est., 2,000.)

History.—Built in '88 by town. Engr. and Contr., John D. Ronald, Brussels.

Water Supply.—Georgian bay, pumping to stand-pipe and direct.

Pumping Machinery.—Cap., 750,000 galls. One duplex horizontal double-acting Worthington pump.

Stand-Pipe.—Is 2¾ ft. in diam. by 100 ft. high.

Distribution.—*Mains*, c. i., 3,500 ft. *Services*, galv. i. *Meters*, none. *Hydrants*, 8.

Pressure: Ordinary, 40 to 50 lbs. Fire, 125 lbs.

Financial.—Cost, $8,000. Debt, $8,000. Int., 6%.

Management.—Town Council. Report by John D. Ronald.

WINDSOR, *Essex Co.* (Pop., 7,000; est., 8,091.) On Detroit river.

History.—Built in '72-3 by city. Des. Engr., F. L. Foster. Const. Engrs. and Contrs., Waterous Engine Works, Brantford. Sub-contr. for masonry and buildings, Jas. Bartlett, Windsor.

Water Supply.—Detroit river, by direct pumping.

Pumping Machinery.—Dy. cap., 2,500,000 galls.; a Waterous engine and rotary and plunger pumps. It is unofficially reported that a 3,000,000-gall. pump was bought in '88, of Kerr Bros., Walkerville.

Distribution.—*Mains*, c. i., 22 miles; from St. Rolloe works, Glasgow, Scotland. *Services*, lead. *Taps*, 2,900. *Meters*, 1. *Hydrants*, kind not given, 166.

Consumption, 900,000. *Pressure*: Ordinary, 40 lbs. Fire, 90 to 120 lbs.

Financial.—Cost, $150,000. Debt, $125,000. Int., 6%. Ann. op. exp., $8,000. Ann. rev.: consumers, $21,000; city, none.

Management.—Supt., J. Hammond. Secy., C. Reid. Chf. Pumping Engr., Jos. Hall.

WINCHAM, *Huron Co.* (Pop., 2,400; est., do.) On Maitland river, which furnishes water-power.

History.—Built in '80 by town. Engr., T. H. Tracy, London. Contr., A. J. Saxton, Toronto.

Water Supply.—Maitland river, by direct pumping.

Pumping Machinery.—Two double-acting 10-in. pumps, of 15-in. stroke, from Goldie & McCullough, Galt.

Distribution.—*Mains*, 6-in. c. i. *Hydrants*, 6.

Pressure: 120 lbs.

Financial.—Cost, $8,000. Bonded debt, $8,000. Int., 6%. Ann. op. exp., $300. No rev.

Management.—Supt., Geo. Pettypiece. Report by W. W. Inglis.

WOODSTOCK, *Oxford Co.* (Pop., 6,300; est., 9,000.) On River Thomas. Manufactures agricultural implements, wood and iron goods. Settled in '30; incorp. a town in '51.

History.—Built in '80 by town for fire purposes and to supply manufactories. Des., Engr., Geo. Ware.

Water Supply.—Cedar creek, by direct pumping.

Pumping Machinery.—Dy. Cap., 1,500,000. galls.; two 750,000-gall. compound Worthington pumps of 10½ bore and 9-in. stroke. Tubular boilers.

Distribution.—*Mains*, c. i., 3 miles. *Services*, 1 ad. *Taps*, for manufactories, 180. *Meters*, 1. *Hydrants*, Whitelaw, 35.

Consumption, 150,000 galls. *Pressure*: Ordinary, 48 lbs. Fire, 80 lbs.

Financial.—Cost, $38,000. Debt, $25,000. Int., 6%. Ann. op. exp., $2,997. Ann. rev.: consumers, $2,132; city none.

Management.—Secy., G. C. Eden.

Water-Works Projected with Fair Prospects of Construction.

PORT ARTHUR, *Thunder Bay District.* (Pop., est., 5,000 to 6,000.) Engaged in mining and manufacturing.

Proposed System.—In '88 surveys for a gravity system were made by Zeph. Malhiot, for the Port Arthur Water-Works Co. Works to be built in '89. Supply to be taken from Current river or Mc Vicar's creek. Cost, est., $150,000. *Mains*, 16 in., 4 miles. Prest., M. Downie. Mgr., Jas. Conner.

PICTOU, *Prince Edward Co.* (Pop., est., 3,200.) On Bay of Quinte.

Proposed System.—Town to build works for fire protection in '89. Engr., Thos. A. Bolger, Kingston. Contr., F. L. de La Vellee, Montreal. *Mains* 8 to 4 in., 4 miles. Cost, est., $30,000. Bonded debt, $30,000. Water to be pumped from Quinte bay to reservoir, 100 ft. sq. Report by W. J. Porte, Mayor.

Water-Works Projects Reported in '87 and '88, but Now Indefinite.

Chatham, *Kent Co.*, Murray Bay; Pembroke, *Renfrew Co.*; Simcoe, *Norfolk Co.*

MANITOBA.

Water-Works Completed or in Process of Construction.

WINNEPEG, (Pop., 8,000; est., 20,000.) On Red river of the North and Assiniboine river in flat prairie country, with deep alluvial soil and clay substratum, overlying limestone rock. It is 640 ft. above sea level. Fort Garry was established here about '20, but until '72 the place was small. Incorp. a city in '74.

History.—Built in '82 by Winnepeg Water-Works Co, Des. Engr., J. Thomson Glasgow, Scotland.

Water Supply.—Assiniboine river, by direct pumping.

Intake Tunnel.—Brick-lined, 3 ft. in diam., leading from river to pump-well.

Pumping Machinery.—Dy. cap., 1,500,000-galls.; two double-acting pumps made by R. Laidlaw & Son, Glasgow, Scotland.

Filter.—National Water Purifying Co.'s plant.

Distribution.—*Mains*, c. i., 20 miles. *Services*, w. i. The first mains were from Scotland, with turned and bored joints. The joints were liable to break. Later hub and spigot joint were used. Pipe is laid 8 ft. deep. *Taps*, *Meters*, *Hydrants*, and *Consumption*, withheld. *Pressure*: Ordinary, 45 lbs. Fire, 80 lbs.

Financial.—Cost, '84, $130,000. In '84 the authorized capital stock was $300,000, of which $150,000 was subscribed, and 55% of the latter paid up. Bonded debt, in '84, $60,000. Int., 6%. Ann. exp. and rev., withheld.

Management.—Prest., Alex. Moffett. Secy., A. B. Elford. Supt. and Res. Engr., J. E. Hannah.

BRITISH COLUMBIA.

Water-Works Completed or in Process of Construction.

VANCOUVER, *New Westminster District.* (Pop., est., 8,500 to 12,000.)

History.—Built in '87-9 by Vancouver Water-Works Co. Ltd. Des. Engr., G. A. Keefer. Const. Engr., H. B. Smith.

Water Supply.—Capilano river, by gravity from impounding reservoir.

Dam.—Is a stone-filled crib dam, 6½ miles above mouth of river, 385 ft. long, 41 ft. wide and 12½ ft. high. Has a tumbling way 165 ft. long, supplemented by a 14 ft. sluice-way. The crest is 417½ ft. above the lowest and 200 ft. above the highest point of the city.

Impounding Reservoir.—Cap., about 14,000,000 galls. Is 380 by 700 ft.

Conduit.—Is about 7¾ miles long, in five sections as follows: First, 22-in. in diam. for 2½ miles; second, a tunnel, 6 by 4 ft., 280 ft. long; third, 16-in. in diam., 4 miles, extending to Burrard inlet; fourth, 12-in. in diam. for 1,086 ft. long, across Burrard inlet; fifth, 16-in., one mile long, extending to Coal harbor, the corporate limits of city. The 22 and 16-in. pipes are of 11-100-in. mild steel plates, riveted, n 23-ft. lengths, and weigh 736 and 552 lbs. respectively. They are warranted to have a tensile strength of 72,000 lbs. per sq. in. The joints are of Smith & Moore pattern,—that is, a band of steel 6 in. wide and ¼ in. thick encircles the junction of two lengths, the space between the band and the pipe being filled up with lead and well caulked. The play between the band and the pipe is sufficient to admit of an angle of 2°. Large angles are turned by means of special bands and castings. Each length is coated inside and out with asphaltum and coal tar. Considerable difficulty was experienced in laying the 12 in. section across Burrard's inlet, and the Contr., J. F. Ward, Jersey City, officially abandoned the work after hauling out 18 of the 105 pipe-lengths. Arrangements were then made with H. F. Keefer and D, McGillivray, Vancouver, who withdrew the 18 lengths of submerged pipe, then dug a trench on the shore 3 by 4 ft. by 1,200 ft. long, laid continuous runners of barked firs upon its bottom, and placed and jointed continuously the 105 pipe lengths thereon. The Ward flexible joint was used. Each length was provided with a wrought-iron ring encircling the pipes, to which buoys of 500 lbs. buoyancy were attached. Thirteen of the original 105 lengths were found defective when tested to 300 lbs. pressure, and were removed, thus leaving 92 lengths in the line. To the end nearest the water was attached a large raft of cedar logs, capable of floating that end when immersed. The hauling gear consisted of four engines, two on each shore, with a combined hauling capacity of 105 H. P. To each of three of these engines was attached a steel cable, 1½ in. in diam., while the fourth connected with a 9-in. manila cable. One cable was placed at each end, one in the center and one midway between center and the end nearest the shore. With the aid of this machinery the pipe was successfully launched in 9 hours. A complete and interesting description of this work, in detail, will be found in *Engineering News*, Vol. 21, p. 91.

Distribution.—*Mains* riveted mild steel, 10 miles. *Services*, c. i., galv. i. *Taps* and *Meters*, not given. *Hydrants*, from Albrion Iron Works, Ltd., Victoria, 75.

Financial.—Cost, $250,000. Capital stock, $250,000. No debt.

Management.—Prest., Capt. John Irving. Secy., J. W. McFarland. Res. Engr., H. B. Smith.

NOTE:—No further information could be given at time of report.

VICTORIA, *Victoria District.* (Pop., est., 12,000.) Engaged in lumbering and coal mining.

History.—Built by city, date not given. Extensive improvements and extensions are being made.

Water Supply.—Creek, by gravity from impounding reservoir on stream, for lower levels of city; and by pumping 5 hrs. per day for higher parts of city.

Dam, Reservoir and Pumping Machinery.—Not described.

Distribution.—*Mains*, 12 to 4 in. c. i., est., 15 miles; from R.D. Wood & Co., Philadelphia, Pa. *Services*, not given. *Taps*, est., 1,738. *Meters*, Worthington, 29. *Hydrants*, from Albion Iron Works, 59.

Financial.—Cost and debt not given. Sinking fund, $245,000. Ann. op. exp., est., $8,630. Ann rev.: est., $38,500.

Management.—Water Com., Peter Summerfield.

NOTE:—The above is subject to corrections, as the only source of information at hand has been the last annual Report of the Com. Estimates were thus necessary in some case.

Water-Works Projected with Fair Prospects of Construction.

ENGLISH BAY, See New Westminster.

NEW WESTMINSTER, *New Westminster District.* (Pop., est., 12,000.) On razer river, 15 miles from its mouth.

Proposed System.—In '86 the Coquitlam Water-Works Co., Ltd., was incorporated to supply New Westminster, Port Moody and English Bay. Supply to be taken from Coquitlam lake. In '88 it was reported works would be built in '89. Prest., Edward Ashley Wilmont. Secy., Arthur Edmund Hill.

PORT MOODY, (Pop., est., 200.) See New Westminster.

SUPPLEMENT.

Reports of New Works Received too late for Classification.

MAINE.

RICHMOND, *Sagadahoc Co.* (Pop., of township, 2,658; est., 3,500.) On Kennebec river, 17 miles from Augusta. Engaged in manufacturing.

History.—Built in '86-7 by Richmond Water Co., under 40 years' franchise. Des. Engr., M. M. Tidd, Boston. Const. Engr., F. Danforth, Gardiner. Contr., J. J. Newman, Providence, R. I.

Water Supply.—Kennebec river, pumping to reservoir.

Pumping Machinery.—A 750,000-gall. Blake pump.

Reservoir.—Cap., 1,000,000 galls.

Distribution.—*Mains*, c. i., 6 miles. *Services*, tarred i. Pipe and specials from Gloucester Iron Works, Philadelphia, Pa. *Taps* and *Meters*, not given. *Hydrants*, Chapman, 40.

Consumption, not given. *Pressure*: 70 lbs.

Financial.—Cost, not given. Capital stock, $100,000. Bonded debt, $60,000. Int., 5%. Ann. op. exp., not given. Ann. rev.: consumers, not given; city, $2,000. Hydrant rental, $50 each.

Management.—Prest., Weston Lewis. Treas., Josiah S. Maxcy, Gardiner, Me. Supt., J. L. Pushard.

WINTER HARBOR, *Hancock Co.* (Pop., est., 800.)

Proposed System.—The Winter Harbor Water Supply Co. intend to begin Construction Apr. 1, and finish July 1, '89. Engr., Ernest W. Bowditch, Boston, Mass. Water to be conveyed by gravity from Birch Haven Pond, both for domestic supply and fire protection. Est. cost $15,000. Prest., D. B. Flint, Commonwealth Ave., Boston Mass. Treas. and Clerk, B. E. Tracey, Winter Harbor.

NEW HAMPSHIRE.

BARTLETT, *Carroll Co.* (Pop., est., 500.)

History.—Built in '86-7 by Bartlett Water Co., after plans by the Prest., P. M. Watson. Labor done by company.

Water Supply.—A mountain brook, by gravity.

Distribution.—*Mains*, 4 and 3-in. coated w. i., 1¾ miles. *Services*, kind, do. *Taps*, 70 *Meters*, not given. *Hydrants*, 17 "stand-pipes."

Consumption, "1,400 galls." *Pressure*: 50 lbs.

Financial.—Cost, $4,000. Capital stock, $3,000. Debt, not given. Ann. op. exp., $100. Ann. rev.: withheld, but est., $800.

Management.—Prest., N. P. Watson. Secy. and Treas., C. H. George. Supt., Frank George.

FRANKLIN, *Merrimack Co.* (Pop., not given.)

Proposed System.—An attempt to start works was made in fall of '88, which failed. It was thought that another attempt would be made soon. Address Town Clerk.

MASSACHUSETTS.

BELMONT, *Middlesex Co.* (Pop., of township, 1,565; in '85, 1,639.)

History.—Built in '87 by town. Engr., E. A. W. Hammatt, with M. M. Tidd as Consulting Engr., both of Boston, Mass.

Water Supply.—From works of Watertown Water Supply Co., under a 5 years' contract.

Distribution.—*Mains*, c. i., 6.8 miles; from Donaldson Iron Co., Emaus, Pa., and originally laid by Jno. T. Langford, Boston; pipe extensions in '88 laid by H. H. Pike. Specials from Builders' Iron Foundry, Providence, R. I. *Taps*, 100. *Hydrants*, Coffin, 51. *Valves*, Coffin.

Financial.—Cost, $44,000. Debt, $43,000. Int., 4%.

Management.—Comrs.: Wm. J. Underwood, T. D. Blake and G. C. H

New Works.

HOUSATONIC, *Berkshire Co.* (Pop., est., 1,000.)

History—Built in '88 by Housatonic Water Co. Des. Engr., Garwood Ferris, Jersey City, N. J. Const. Engr., T. Z. Potter, Housatonic.

Water Supply.—Long Lake, with an area of 160 acres, by gravity.

Distribution.—*Mains*, c. i., 6 miles. *Services*, galv. i. Pipe and specials bought of M. J. Drummond, New York City, and trenching and pipe-laying done by Ferris & Halladay, Jersey City, N. J. *Taps*, 60. *Meters*, Crown, 2. *Hydrants*, New York, 16. *Valves*, Ludlow.

Pressure: 75 lbs.

Financial.—Cost, $60,000. Capital stock, $40,000. Bonded debt, $40,000. Int., 6%.

Management.—Prest., Henry J. Harrigan. Treas., O. C. Houghtaling. Supt., T. Z. Potter.

LUDLOW, *Hampden Co.* (Pop., of town, 1,526; est., 1,700.)

General Description.—Supplied with water from Springfield water-works. No other information given.

NORTH EASTON, *Bristol Co.* (Pop., est., 2,500.) In township of Easton.

History.—Built in '87-8 by North Easton Fire District. Engr., Percy M. Blake.

Water Supply.—Collecting well, pumping to stand-pipe and direct. The well is near Queset river, 27.7 ft. deep, 26 ft. in diam. at bottom and 28½ ft. at top. The first 4 ft. from the bottom is lined with a dry wall of large stone, and the remaining distance with dry stone work, with an interior 12-in. brick lining in cement, water tight.

The well has a storage cap., available for pumping, of about 100,000 galls. It is covered with a conical roof, with provision for ventilating. Contr., Jno. A. Gill, East Boston.

Pumping Station.—Of brick, with slate roof. The chimney is 75 ft. high, and has a core 30 in. in diam. The floor of the engine-room is 150 ft. above high water in reservoir, and 28.7 ft. above bottom of suction pipe at well. Contr., Geo. Howard, Brockton.

Pumping Machinery.—Dy. cap., 1,200,000 galls.; two 600,000 gall. compound condensing duplex Worthington pumps, each with 9-in. high, and 16-in. low-pressure cylinders, and 8½-in. water plungers, all of 10-in. stroke. There are two Whittier boilers, each 4½ by 13 ft., and each with 22½ sq. ft. of grate surface.

Suction and Force Mains.—The former is 12, and the latter 10 in. in diam.

Stand-Pipe.—Cap., 235,000 galls.; 20 ft. in diam. by 103 ft. high, high water level being 3 ft. from top.

A 10-in. pipe, 90 ft. high, is placed in the center of the stand-pipe, connecting with the force main. It is provided at its base with an automatic check valve, set on a branch pipe, which closes when the pumps are working, and opens when water passes out of the reservoirs.

The top of the pipe has a wooden cover, and the whole is surmounted by an ornamental top. The foundation was built by day's labor, and is 7 ft. deep, of stone masonry in cement, with brick entering arch and interior well for supply and discharge pipe. The pipe is secured to the masonry by six 2-in. anchor bolts.

Distribution.—*Mains*, c. i., tarred, about 6 miles; from Gloucester Iron Works, Philadelphia, Pa., and laid by Chas. H. Eglee, Flushing, N. Y. *Services*, enam. i.; connections made by O. N. Bingham, Dedham. *Taps*, 142. *Meters*, not given. *Hydrants*, Ludlow, 57. *Valves*, Ludlow.

Consumption, not determined. *Pressure*: Ordinary, 60 lbs. Fire, 180 lbs.

Financial.—Cost, to Mar. 1, '88, $82,523.

Management.—Comrs.: Oliver Ames, Frederick L. Ames and Geo. B. Cogswell.

ORANGE, *Franklin Co.* (Pop., of township, 3,169; est., 3,650.) Manufactures sewing machines, furniture and water wheels.

History.—Built in '75 by New Home Sewing Machine Co.

Water Supply.—Spring, by gravity from reservoirs, with pumping from Miller's river in dry weather.

Reservoirs.—The first has an area of ¼ acre, and a depth of 8 ft. From this water passes to a reservoir 30 ft. sq. by 12 ft. deep.

Distribution.—*Mains*, w. i. and cement, length not given. *Services*, w. i., lead. *Taps*, not given, but about 100 families are supplied.

New Works.

RHODE ISLAND.

OLNEYVILLE, *Providence Co.* (Pop., 5,765.)

History.—Supplied in '75 from Pawtuxet Water-Works, Providence, and a part of the Providence system. Hydrant rental, $30 each for 36 hydrants. Water Comr., W. D. Harris.

All other data included under Providence.

NEW YORK.

ALFRED CENTRE, *Allegany Co.* (Pop., est., 900.)

Proposed System.—To be built by company. Address D. S. Burdich.

ELMIRA, *Chemung Co.* (Pop., 20.541; est., 27,000.) On Chemung river, in a narrow valley. Settled in 1787; incorp. a city in '64.

History.—Built in '60-1 by Elmira Water-Works Co., under a perpetual franchise. Des. Engrs., Alphonse Fteley and Francis Collingwood. Const. Engr., R.M. McDonnell. Labor done by Co.

Water Supply.—Carr's creek, filter galleries near Chemung river, and Chemung river, by gravity from storage reservoir on creek to distributing reservoir, and by pumping to reservoir from filters and river.

The creek has a drainage area of 4½ sq. m.

Dam.—Across creek to form storage reservoir. Is 1,100 ft. long, 36 ft. high, 10 ft. wide on top, and paved with stone on the inner slope.

Reservoir.—Cap., about 100,000,000 galls.; has an area of 26 acres, at 210 ft. above city. A canal 25 ft. wide extends along one side of the reservoir to carry off surplus and turbid water.

Conduit to Distributing Reservoir.—A 16-in. c. i. pipe extends through the dam, and connects with a 12-in. w. i. and cement pipe, 4,500 ft. long, which turns up at the distributing reservoir, making a fountain jet.

Distributing Reservoir.—Cap., not given; 300 ft. sq., and 90 ft. above river.

Filter Gallery.—Is in gravel, 100 ft. from Chemung river. 5 ft. wide and 216 ft. long. In '82 its dy. yield was about 1,750,000 galls. It is 90 ft. below distributing reservoir.

Pumping Machinery.—Dy. cap., 9,000,000 galls.; a 3,000,000-gall. Knowles pump, erected in '80, and a 6,000,000-gall. high duty Worthington pump, put in since.

Distribution.—*Mains*, 20 to 4-in. c. i., 40 miles. *Services*, lead, galv. i. Pipe and specials from Mellert Pipe Foundry Co., Reading. *Taps*, 1,500. *Meters*, "Crown and others," 300. *Hydrants*, Mathews, 224. *Valves*, Eddy.

Consumption, 2,250,000 galls. *Pressure*: 44 lbs.

Financial.—Cost, $522,000. Capital stock, $200,000. Bonded debt, $300,000. Int., 6%. Ann. op. exp., $13,000. Ann. rev.: consumers, $30,000; city, $10,000 for all purposes.

Management.—Prest., A. S. Diven. V. Prest., G. M. Diven. Secy., Treas. and Supt., J. M. Diven.

FRANKLINVILLE, *Cattaraugus Co.* (Pop., 672; est., 1,000.) Has some manufactories.

Proposed System.—There is talk of building gravity works in '89, at an est. cost of $20,000; capital not secured. Supply, springs. Village Prest., P. T. Button.

FULTONVILLE, *Montgomery Co.* (Pop., 881; est., 1,700.) In Glen township, on Mohawk river. Has manufactories.

History.—Built in '75 by J. H. Starin. Engr., Henry Bigerman.

Water Supply.—Springs, by gravity to small reservoir, thence by pumping to larger reservoir.

Pumping Machinery.—Seneca Falls pump, dy. cap. not given.

Reservoir.—But one is described; cap., 165,000.

Distribution.—*Mains*, 4-in. w. i., 4½ miles. *Services*, not given. *Taps*, 148. *Meters* none. *Hydrants*, Mathew, 13. *Valves*, Chapman.

Pressure: Ordinary, 65 lbs. Fire, 80 lbs.

New Works.

Financial.—Cost, $17,000. Capital stock, $17,000. Debt, not given. Ann. op. exp., $400. Ann. rev.: consumers, $600; city, none. Hydrants, free.

Management.—Owner, J. H. Starin.

GROTON, *Tompkins Co.* (Pop., 913; est., 1,400.) On Owasco Inlet. Manufactures carriages, cutters and agricultural implements.

History.—Built in '88 by village, and put in operation Dec. 1. Engrs. and Contrs., Reynolds & Morgan, Cuba.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 400,000 galls.; 69 by 90 ft., by 11 ft. deep. Is about ¼ mile from, and 210 ft. above the main street.

Distribution.—*Mains*, 10 to 4-in. c. i., 5¼ miles; from Chas. Millar & Son, Utica. *Hydrants*, Bailey, 45. *Valves*, Eddy.

Pressure: 85 lbs.

Financial.—Cost, $23,000. Bonded debt, $23,000. Int., 3½%.

Management.—Prest., Ben. Conger. Secy., W. D. Baldwin.

HANCOCK, *Delaware Co.* (Pop., of township, 3,238.)

Proposed System.—The Hancock Water Co. was organized in '88, and hopes to build works in '89 at an est. cost of $12,000. Engr., Geo. Cowan, Stamford, Delaware Co. Report by G. A. Allen.

LITTLE VALLEY, *Cattaraugus Co.* (Pop., 566; est., 1,200.)

History.—Built in '88 by village, under direction of Board of Trustees.

Water Supply.—Springs, by gravity.

Reservoir.—Cap., about 1,000,000 galls.

Distribution.—*Mains*, 6 and 4-in. w. i., 5 miles. *Taps*, 120. *Meters*, none. *Hydrants*, Ludlow, 16.

Pressure: 100 lbs.

Financial.—Cost, $13,000. Debt, $12,500. Int., 4%. Ann. rev.: consumers, est., $900.

Management.—Address Saml. Dunham.

NEW YORK MILLS, *Oneida Co.* (Pop., est., 3,000.) Manufactures cotton goods.

General Description.—The New York Mills have a small system chiefly for the use of their mills. Spring water is furnished to a few families for domestic use. Water is pumped direct to mains from three reservoirs on Sanquint creek, having a combined cap. of about 1,000,000 galls. *Mains*, iron, 2 miles. *Hydrants*, 51. *Pressure*, 150 lbs.

SCHENEVUS, *Otsego Co.* (Pop., est., 1,000.)

History.—Built in '88 by Schenevus Village Water-Works Co., after plans by the Prest., C. H. Graham. Const. Engr., Julian Hubbard. Labor done by Co.

Water Supply.—Source, not given, by gravity.

Reservoir.—Cap., not given. Formed by cement wall 75 ft. long and 20 ft. high, wall founded on bed rock.

Distribution.—*Mains*, 6-in. c. i., 2¼ miles. *Taps*, 75. *Hydrants*, about 20.

Pressure: 300-ft. head.

Financial.—Cost, $15,000. Capital stock, $7,500. Bonded debt, $13,000. Int., 6%. Ann. rev.: consumers, $1,600; $800 being from a R. R. Co.; city, $350.

Management.—Prest., C. H. Graham. Secy. and Treas., Geo. Brooks. Supt., J. Warren Lamb.

SEA CLIFF, *Queens Co.* (Pop., est., 1,000.)

History.—Built for domestic supply in '72 by Sea Cliff Grove & Metropolitan Camp Ground Assn. of N. Y. and Brooklyn. Labor done by Co.

Water Supply.—Seven driven wells, pumping to tank.

Pumping Machinery.—Worthington pump, dy. cap., not given.

Tank.—Cap., 28,000 galls.; 18 ft. in diam. by 15 ft. high.

Distribution.—*Mains*, c. i., 5 miles. *Services*, lead. Pipe and specials from Jno. Simmons. *Meters* and *Hydrants*, none.

Consumption and *Pressure*, not given.

Financial.—Cost, $5,000. Ann. op. exp., $1,200. Ann. rev.: consumers, about $1,500.

Management.—Prest., J. T. Pirie. Secy., J. K. Myers.

New Works.

WHITESVILLE, *Allegany Co.* (Pop., not given.)

General Description.—Built in fall of '88 by Whitesville Water Co. Contrs., Hardwicke & Ware, Buffalo. Water is conveyed by gravity from springs to reservoir. *Mains*, c. i., 4 miles. *Services*, galv. i. *Taps*, about 30.

NEW JERSEY.

HADDONFIELD, *Camden Co.* (Pop., 1,480; est., 2,500.)

History.—Built in '86-7 by Haddonfield Water Co. Engr. and Contr., Malcolm Peters, Philadelphia, Pa.

Water Supply.—Small spring-fed stream, pumping from impounding reservoir to stand-pipe. The stream has a dy. flow of 400,000 galls.

Impounding Reservoir.—Not described.

Pumping Machinery.—A 700,000-gall. Worthington pump.

Stand-Pipe.—Cap., 145,000 galls.; 15 ft. in diam. by 110 ft. high. From Cunningham Iron Works, Boston, Mass.

Distribution.—*Mains*, 6 to 3-in. kal. i., 4½ miles; from National Tube Works Co., McKeesport, Pa. *Services*, galv. i. *Taps*, 125. *Meters*, Worthington, Thompson, 13. *Hydrants*, Chapman, 20. *Valves*, Chapman, Ludlow.

Consumption, 12,000 galls. *Pressure*; 40 lbs.

Financial.—Capital stock, $40,000. Anu. op. exp., $1,000. Ann. rev.: city, $2,000. Hydrant rental, $25 each for first 20, and $30 each for additional.

Management.—Prest., Wm. H. Snowden. Treas., C. H. Hillman. Supt., D. S. Barnard.

MOORESTOWN, *Burlington Co.* (Pop., est., 2,000.)

History.—Built in '87-8 by Moorestown Water Co., with W. W. Taylor, Charleston, W. Va., as Engr. and Contr. at first, and afterwards, the Pennsylvania Pipe Mfg. Co., Germantown Junction, Pa.

Water Supply.—Impounding reservoir filled by 5 small spring-fed streams, pumping to tank and direct. Water flows by gravity from reservoir to pump, about 1,500 ft.

Reservoir.—Not described.

Pumping Machinery.—A 1,000,000-gall. Blake duplex pump.

Tank.—Cap., about 70,000 galls.; 23 ft. in diam. by 85 ft. high. Of cedar, placed on a circular brick tower 48 ft. high, the tower having stone and cement foundations, and the tank being roofed. The tank is 2½ miles from, and its top is 150 ft. above the reservoir.

Distribution.—*Mains*, w. i. and cement, about 7½ miles; from Penn. Pipe Mfg. Co., Germantown Junction, Pa. *Taps*, 42. *Meters*, 1. *Hydrants*, 50.

Consumption, 15,000 galls. *Pressure*: Ordinary, 65 lbs. Fire, 100 lbs.

Financial.—Cost, $40,000. Capital stock, $40,000, all paid up. No debt. Ann. op. exp., est., $1,500. Ann. rev.: consumers, est., $2,000; city, $1,000. Hydrant rental, $20 each.

Management—Prest., N. Newlin Stokes. Secy. and Treas., Saml. K. Robbins.

WENONAH, *Gloucester, Co.* (Pop., est., 500.)

History.—Built in '85 by Wenonah Water Co. Engrs., and Contrs., R. D. Wood & Co., Philadelphia, Pa.

Water Supply.—Spring, pumping to tank and direct.

Pumping Machinery.—A 300,000-gall. Worthington pump driven by water-power, with steam engine in reserve.

Tank.—Of wood, Cap., 59,000 galls.

Distribution.—*Mians*, 6 to 3-in. c. i, 2 miles. *Taps*, 60. *Hydrants*, Mathews, 12. *Valves*, Eddy.

Consumption, 25,000 galls. *Pressure*: Ordinary, 42 lbs. Fire, 90 lbs.

Financial.—Cost, $10,000. Capital stock, $10,000. Debt, not given. Ann. op. exp., $450 Ann. rev.: consumers, $850; city $120. Hydrant rental, $10 each.

Management.—Prest., Stephen Greene, 27 S. 5th St., Philadelphia, Pa. Secy., Edw. L. Farr. Supt., Blair Smith. Report by Geo. M. Bailey.

New Works.

DELAWARE.

MIDDLETOWN, *New Castle Co.* (Pop., 1,280; est., 2,000.)

General Description.—Owned by town. Worthington pumps with a dy. cap. of about 600,000 galls. are used. *Pressure*: 85 lbs. Address Town Comrs.

NEWARK, *New Castle Co.* (Pop., of township, 1,148; est., 2,000.) Has manufactories.

History.—Built in '88-9 by town, and put in operation in Feby. Des. Engr., Isaac S. Cassin. Const. Engr., Isaac S. Cassin, Jr. Both of Philadelphia, Pa. Contr. for labor, Jos. Hyde, Wilmington.

Water Supply.—Well, pumping to stand-pipe and direct. The well is 20 ft. in. diam. by 35 ft. deep.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; all from Holly Mfg. Co., Lockport, N. Y. Two 500,000-gall. compound duplex pumps, and two 4½ by 12-ft. boilers.

Stand-Pipe.—Cap., 186,000 galls.; 25 ft. in diam. by 50 ft. high, on an elevation of 50 ft. Built by Basshor & Co., Baltimore, Md. Its top is 140 ft. above lower parts of the town. It is about a mile from the pump.

Distribution.—*Mains*, 10 to 6-in. c. i. 3½ miles *Services*, galv. i., w. i., lead. Pipe and specials from McNeal Pipe & Foundry Co., Burlington, N. J. *Meters*, none. *Hydrants*, from Union Hydraulic Co., Philadelphia, Pa., 35. *Valves*, kind, do. *Pressure*: Ordinary, 56 lbs. Fire, 125 lbs.

Financial.—Cost, about $35,000. Bonded debt, $30,000. Int., 5%. The R. R. Co. has contracted for water for one year, at $480.

Management.—Town Council. Pumping Engr., Jas. Hayes.

PENNSYLVANIA.

ADRIAN MINES, *De Lancey P. O., Jefferson Co.* (Pop., est., 1,300.)

History.—Built in '86 by Rochester & Pittsburg C. & I. Co. Engr., W. F. Arms, Punxsutawney.

Water Supply.—Artesian well, 300 ft. deep, pumping to tank.

Pumping Machinery.—A No. 106, Cameron pump.

Tank.—Cap., 8,000 galls.

Distribution.—*Mains*, 4-in. c. i., 3 miles; from Buffalo (N. Y.) Cast-Iron Pipe Co. *Taps*, 18. *Hydrants*, none.

Consumption, 4,000 galls.

Financial.—Cost, $5,000. Ann. op. exp., $3,600. Water furnished to residents free.

Management.—Prest., Franklin Platt, 150 Chestnut St., Philadelphia. Supt., J. H. Bell. Report by A. M. Armstrong.

APOLLO, *Armstrong Co.* (Pop., 1,156; est., 6,000.) Engaged in coal mining and iron industries.

History.—Built in '88 by Apollo Water Co. Contr., R. B. Thomas, Clarion, Pa.

Water Supply.—Kiskiminates river, pumping to tanks.

Pumping Machinery.—Keystone pump, dy. cap. not given.

Tanks.—Four, cap. not given.

Distribution.—*Mains*, 8 to 4-in. iron, length not given; from National Foundry & Pipe Works, Scottdale, Pa. *Hydrants*, Ludlow, 20. *Valves*, Ludlow.

Financial.—Cost, $15,000. Capital stock, and bonds, $25,000. Hydrant rental, $25 each.

Management.—Supt., S. T. Stringfellow.

AUSTIN, *Potter Co.* (Pop., est., 1,300.)

General Description.—Built in '88-9. Contrs., Hardwicke & Ware, Buffalo, N. Y. *Mains*, c. i., about 3 miles. No further information given.

BANGOR, *Northampton Co.* (Pop., 1,328; est., 3,100.) Has manufactories and slate quarries.

History.—Built in '86 by Bangor Water Co., under perpetual franchise. Engr., Marshall J. Young, Easton.

New Works.

Water Supply.—Spring, by gravity.

Reservoir.—Small.

Distribution.—*Mains*, 8 to 4-in. iron. 4¼ miles. *Services*, galv. i. *Taps*, 100. *Meters*, Crown. *Hydrants*, Ludlow, Tamaqua, 10. *Valves*, Ludlow.

Financial.—Capital stock, $20,000. Bonded debt, $15,000. Int., 6%.

Management.—Prest., J. Marshall Young, Easton, Pa. Treas., Frank L. Lesher.

CAMBRIA, *Johnstown P. O., Cambria Co.* (Pop., not given.)

Proposed System.—The Morrelville & Cambria Boro Water Co. will build works in '89, putting them in operation June, 1. There will be a dam and 3 miles of mains. Capital stock, $40,000. Bonds, $20,000. Officers: Jno. Dowling, J. J. Strayer and Jno. Kintz. Report by Jno. C. Ryan.

DRIFTON, *Luzerne Co.* (Pop., est., 1,300.)[1]

General Description.—Built by Coxe Bros. & Co. Contr. for pump, boiler, pipe and specials, Geo. W. Hodesty; for trenching and pipe-laying, Jno. Wagner. *Mains*, 3 miles. *Taps*, 58. Report by W. H. Butts.

ETNA, *Allegheny Co.* (Pop., 2,334; est., 4,000.)

History.—Built in '88 by Etna Water Co. A 20 years' hydrant contract. Des. Engr., Jas. H. Harlow. Const. Engr., Edw. J. Harlow. Contrs., Jas. H. Harlow & Co. All of Pittsburgh, Pa.

Water Supply.—Allegheny river, pumping to tank.

Pumping Machinery.—Dy. cap., 1,500,000 galls.; two 750,000-gall. Smith & Vaile pumps.

Tank.—Cap., about 500,000 galls.; 40 ft. in diam. by 35 ft. high.; from J. B. Witherow.

Distribution.—*Mains*, c. i., 4 miles; from National Foundry & Pipe Co., Scottdale, Pa. *Hydrants*, Mathews, 30. *Valves*, Ludlow.

Financial.—Hydrant rental, 30 at $50 each; additional at $50 each for first 10 years, and $40 each for second 10 years.

Management.—Prest., Geo. A. Chalfant. Supt., Chas. W. Drake.

HORATIO, *Jefferson Co.* See Reynoldsville, under corrections and additions.

EVERETT, *Westmoreland Co.* (Pop., not given.)

NOTE:—These works are connected with those supplying Mt. Pleasant. Supt., C. S. Overholt. No further data.

LOCUST MOUNTAIN WATER CO.'S PLANT, *Columbia Co.* The works are 3 miles from Centralia.

History.—Built in '82-4 to supply Mt. Carmel and Centralia in the dry season, and also the Northern Central R. R. Co., the Lehigh Valley R. R. Co., and Collieries. Engr., Thos. S. McNair, Hazleton.

Water Supply.—Roaring creek, pumping to reservoir.

Storage Reservoir.—Cap., 36,375,000 galls.

Pumping Machinery.—Dy. cap., 4,800,000 galls.; two 2,400,000-gall. compound Worthington pumps.

Distributing Reservoir.—Cap., 2,000,000 galls.

Distribution.—*Mains*, 18 to 4-in. c. i., 14 miles. *Taps*, 15. *Meters*, from National Meter Co., 15. *Hydrants*, none.

Consumption, 111,940 galls.

Management.—Prest., Jas. T. Blakslee. Supt., Chas. A. Blakslee, Mauch Chunk.

LUZERNE, *Luzerne Co.* (Pop., not given.)

NOTE:—There are works owned by a Co., of which J. H. Coon is the head, but no further information can be obtained.

MILLBROOK, *Mercer Co.* (Pop., not given.)

History.—Built in '88-9 by Millbrook Water Co., Oscar Moore, Scranton, is connected with the works. No other data.

MOOSIC, *Lackawanna Co.* (Pop., est., 5,000.)

History.—Built in '86-7 by Spring Brook Water Co., without an Engr. The charter covers Avoca, otherwise known as Pleasant Valley.

The above Co. has leased the small system of the Moosic Water Co., and the

New Works.

same are included below. Contr. for buildings, Geo. B. Foster, Duryea; for reservoir, C. F. Kinsley, Scranton; other labor done by the day.

Water Supply.—Spring brook, pumping to reservoir.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; from W. F. Mattes, Scranton.

Reservoir.—Cap. 1,250,000 galls.

Distribution.—*Mains*, 12 to 4 in. iron, 12 miles. *Services*, galv. i. Pipe and specials from Jackson & Woodin Mfg. Co., Berwick, and Warren Foundry & Machine Co., Phillipsburg, N. J. *Taps*, 375. *Meters*, National Meter Co.'s, 2. *Hydrants*, Tamaqua, 8. *Valves*, Eddy.

Consumption, 500,000 galls. *Pressure*: 70 to 140 lbs.

Financial.—Cost, $54,000. Capital stock, paid up, $30,000; authorized, $50,000. Bonded debt, $15,000. Int., 6%. Ann. op. exp., $1,700. Ann. rev.: consumers, $6,620; city, $280. Hydrant rental, $35 each.

Management.—Prest., O. E. Chittenden. Secy., L. A. Waters. Treas., A. H. Christy. All of Scranton. Supt., Wm. Monie, Moosic.

MOUNT PLEASANT, *Westmoreland Co.* (Pop., 1,197; est., 3,800.) In coke district.

NOTE.—The works here are connected with those supplying Everett, with C. S. Overholt as Supt. No further data.

PLEASANT VALLEY, *Avoca P. O., Bucks Co.* (Pop., not given.) Three miles from Pittston. See Moosic, under History.

TAYLORVILLE, *Bucks Co.* (Pop., not given.)

History.—Built in '88-9 by Taylorville Water Co. Prest., Lemuel Amermann. No further data.

UREKA, *Fisher P. O., Clarion Co.* (Pop., est., 800.)

History.—Built in '87 by H. G. Fisher, Miller & Co. Contr., B. B. Thomas Clarion.

Water Supply.—Mahoning river, pumping to tanks.

Pumping Machinery.—Cameron pump, cap., not given.

Tanks.—Not described.

Distribution.—*Mains*, 6 and 4-in. c. i., 2 miles. *Taps*, 100. *Hydrants*, 5.

Consumption, about 36,000 galls.

Financial.—Cost, $9,400. Ann. op. exp., $800.

Management.—Supt., Wm. Kirkwood, Fisher.

VIRGINIA.

SOUTH BOSTON, *Halifax Co.* (Pop., est., 2,000.)

Proposed System.—The village was to let contracts on Dec. 10, '88; water to be pumped from Dan river to stand-pipe, at an est. cost of $20,000, which has been appropriated. Engrs., C. A. Ballou. Chn. Com., W. D. Barbour.

GEORGIA.

CARTERSVILLE, *Bartow Co.* (Pop., 2,037.)

Proposed System.—Jeter & Boardman, Macon, have a conditional contract, but the latter part of Dec., '88, no plans had been made.

CATOOSA SPRINGS, *Ringold P. O., Catoosa Co.* (Pop., not given.)

General Description.—Owned by a Co. Prest. and principal stockholder, J. H. Warner. No further data.

FLORIDA.

KISSIMMEE, *Osceola Co.* (Pop., est., 1,400.)

Proposed System.—The Kissimmee Water Co. was organized in '88, with a capital stock of $40,000. No further data.

New Works.

TALLAHASSEE, *Leon Co.* (Pop., 2,494; est., 3,500.)

Proposed System.—Mar. 2, '89, B. A. Meginniss stated that the town was then negotiating with the Tallahassee Water-Works Co., who proposed to pump water from artesian wells to stand-pipe. Est. cost, $40,000. Work would begin Aug. 1, '89, or earlier, and be finished in 18 months. Address Geo. W. Saxon.

ALABAMA.

FITZPATRICK'S, *Bullock Co.* (Pop., not given.)

General Description.—The Central R. R. & Banking Co. of Ga. have an artesian well, and supply water for domestic use. No hydrants, but two have been proposed. Report by C. A. Sheally.

GATE CITY, *Jefferson Co.* (Pop., not given.) A suburb of Birmingham.

Proposed System.—There is talk of introducing a supply by extending the mains of the Birmingham Water-Works Co.

MISSISSIPPI.

JACKSON, *Hinds Co.* (Pop., 5,204; est., 6,000.) On Pearl river.

History.—Built in '88-9 by Jackson Light, Heat & Water Co. Contrs., Moffett, Hodgkins & Clarke, Watertown, N. Y. Address R. L. Saunders, Jackson.

No further data.

NATCHEZ, *Adams Co.* (Pop., 7,058; est., 10,000.)

Proposed System.—A company to be granted a franchise, with provision that the city may buy the works at the end of 10 years, or of any succeeding year. Supply to be pumped from Mississippi river, through filters, thence to stand-pipe. To be two 2,000,000-gall. high service vertical pumping engines. Stand-pipe to be not less than 22 ft. in diam. and 150 ft. in height. Mains to be from 14 to 4-in. c. i., coated with Dr. Angus Smith's preservative. To be not less than 25 hydrants. Specifications embodying the above were adopted by the Mayor and Aldermen, Jan. 23, '89.

TENNESSEE.

SHELBYVILLE, *Bedford Co.* (Pop., 1,868; est., 3,000.) Has manufactories.

General Description.—An engine in a mill drives a pump which lifts water from a river. An extension of the system, and a stand-pipe, has been proposed. Chn. Com., E. Blakeman.

KENTUCKY.

GLASGOW, *Barren Co.* (Pop., 1,510; est., 3,000.)

History.—Built in '82 by Glasgow Water Co. Contrs., Fairbanks, Morse & Co., Chicago, Ill.

Water Supply.—Spring, pumping to reservoir.

Reservoir.—Cap., about 100,000 galls.

Distribution.—*Mains*, 4-in.

Financial.—Cost, $10,000. Capital stock, $10,000. No debt. Ann. op. exp., $600. Ann. rev.: city, about $1,200.

Management.—Prest., W. L. Porter. Secy., Treas. and Supt., T. P. Dickinson.

OHIO.

DENNISON and URICHSVILLE, *Tuscarawas Co.* (Pop.: Dennison, 1,518; Urichsville, 2,790. Combined est. pop., 7,000.) In Mill township, on opposite sides of small creek.

New Works.

History.—Built in '88 by Dennison Water & Supply Co., under a 25 years' franchise. Engr., C. M. Bennett, Richmond, Ind. Contrs., McCormick & Moran, Pittsburgh, Pa.

Water Supply.—Big Stillwater creek, through filter gallery to receiving well, thence by pumping to reservoir.

Filter Gallery and Receiving Well.—The gallery is 190 ft. long, and ends in a well 25 ft. in diam. by 24 ft. deep.

Pumping Machinery.—Dy. cap., 3,000,000 galls.; two 1,500,000-gall. Worthington pumps.

Force Main.—Of 12-in. cast-iron, 2,800 ft. long.

Reservoir.—Cap., 3,000,000 galls.: sides are lined with brick.

Distribution.—*Mains*, 14 to 6 in. c. i., 10¾ miles. *Services*, lead. *Meters*, Worthington, number not given. *Hydrants*, Ludlow, 103. *Valves*, Ludlow.

Consumption, est., 500,000. *Pressure*: 80 lbs.

Financial.—Cost, $120,000. Ann. rev.: cities, $3,700. Hydrant rental, $40 each.

Management.—Prest., C. S. Simmons. V. Prest. and Supt., Chas. B. Street. Secy. and Treas., M. Moody.

MOUNT GILEAD, *Morrow Co.* (Pop., 1,216; est., 12,000.) Manufacturing town on east branch of Olentangy river.

General Description.—Small system owned by F. A. Talmage & Bro. Water for domestic use is brought by gravity from a small spring to the village square. No further data.

PORTSMOUTH, *Scioto Co.* (Pop., 11,321; est. 2,000.) At junction of Scioto and Ohio rivers, on a nearly level plateau extending back about a mile from the river to a range of hills. Engaged in manufacturing. Settled in 1796; incorp. a town in '15.

History—Built in '71 by city. Des. Engr., W. C. Weir.

Water Supply.—Ohio river, by direct pumping.

Intake.—A brick and wood conduit, 210 ft. long.

Pumping Machinery.—Cap., not given; in '82 there were six 14-in. Holly piston pumps, of 14-in. stroke.

Distribution.—*Mains*, 16 to 4-in. c, i., 20 miles. *Services*, w. i. *Taps*, about 1,300. *Hydrants*, 100.

Consumption, about 2,000,000 galls. *Pressure*: Ordinary, 45 lbs. Fire, about 100 lbs.

Financial.—(*For* '82,) Cost, $200,000. Bonded debt. $150,000. Int., 8%. Ann. op. exp., $11,596. Ann. rev.: consumers, $13,881.

Management.—Address W. A. Harper, or S. G. McCulloch.

URICHSVILLE *Tuscarawas Co.* See Dennison and Urichsville.

MICHIGAN.

OWOSSO, *Shiawassee Co.* (Pop., 2,501; est., 7,000.) On Shiawassee river Has manufactories.

Proposed System.—The city to issue bonds to build works in '89 at an est. to cost $40,000. Water would be pumped from wells directly to mains. Chn. Com., C. C. Williams. Secy., A. S. Williams.

ILLINOIS.

ROGERS PARK, *Cook Co* (Pop., 529, est., not given.)

Proposed System.—The Rogers Park Water Co. has let contract for works to be built in '89. Engr. Chester B. Davis. Contr., Geo. C. Morgan. Both of Chicago. Water will be pumped from Lake Michigan to a stand-pipe. There will be an intake pipe, receiving well and two American filters. The pumps will have a cap. of [illegible],000 galls. and the stand-pipe will be 12 by 100 ft. The company also proposes to put in an electric light plant. Capital stock, $50,000. Prest., H. E. Keeler. Secy., F. D. Keeler. Treas., N. A. Partridge. Offices, corner of Clinton and Fulton Sts., Chicago.

New Works.

WASHINGTON HEIGHTS, *Cook Co.* (Pop., est., 2,000.)

Proposed System.—Two or three attempts have recently been made to introduce water, the latest by the Calumet Water Supply Co., which proposes to bring water from the Hyde Park water-works, 4 miles distant, to the village, the village to lay some 13 miles of distributing mains. The price proposed is $30 per 1,000,000 galls., if 60,000 galls. a year are taken, with an increasing rate for a lesser amount; if only 10,000,000 galls. were taken the rate would be $250 per 1,000,000 galls. The citizen's Ass'n opposes this plan, as Hyde Park recently offered the village water at from $40 to $45 per 1,000,000 galls. Address C. F. Claussen.

MINNESOTA.

CLOQUET, *Carlton Co.* (Pop., est., 1,200.) Has water-power.

NOTE:—Water-works are reported with F. P. Thompson, Prest., Jas E. Page Treas., H. B. Allen, Secy., Wm. M. Kinnon, Supt., and Thos. Berroy, Pumping Engr No further data.

KANSAS.

UKA, *Pratt Co.* (Pop., est., 500.)

History.—Built in fall of '88, but nothing further can be ascertained.

MEDICINE LODGE, *Barber Co.* (Pop., 373; est., 1,800.)

Proposed System.—In Mar., '89, plans for work were being made by Kenneth Allen, Kansas City, Mo.

OSAGE CITY, *Osage Co.* (Pop., 2,098; est., 4,500.)

History.—Built in '88. City Clerk, L. L. Bodell. No further data.

PRATT, *Pratt Co.* (Pop., est., 600.)

NOTE:—In answer to inquiry M. Coals says "we have a very good system here in running order." No further data.

SPRINGFIELD, (Pop., est., 1,200.) See p. 445.

History.—To be put in operation Apr., '89. The franchise runs 20 years. Des. Engr., J. S. Humphrey, Garden City. Const. Engr., Ed. A. Watson, Springfield.

Water Supply.—Well, pumping to stand-pipe.

Pumping Machinery.—A 700,000-gall. Dean pump, and Dean boiler.

Stand Pipe.—Cap., 67,800 galls.; 12 ft. in diam. by 80 ft. high. Built by E. E. Palmer & Son, Kansas City, Mo.

Distribution.—*Mains*, 10 to 6 in. c. i., 1¼ miles. *Services*, lead, galv. i. Pipe and specials from South Pittsburg (Tenn.) Foundry. Trenching and pipe-laying done by Jno. E. Ford, Newton. *Meters*, Crown. *Hydrants*, Chapman, 20. *Valves*, Chapman.

Financial.—Cost, $26,000. Capital stock, $30,000. Bonded debt, $16,000. Int., 7%.

Management.—Supt., Ed. Watson. Report by L. M. Turner.

NEBRASKA.

LONG PINE, *Brown Co.* (Pop., est., 700)

NOTE:—There are works and W. J. Courtwright can give information.

DAKOTA.

COLUMBIA, *Brown Co.* (Pop., 133; est., 800.) On James river.

General Description.—Owned by village. Water is taken from a flowing artesian well with a natural pressure of 180 lbs. Chn. Com., Jno. Nelson. No further data.

New Works.

WYOMING.

DOUGLAS, *Converse Co.* (Pop., est., 1,000.)

Proposed System.—The village wishes works, supply to be taken from an ar- sian well. Address H. R. Wilcox.

SUNDANCE, *Crook Co.* (Pop., not given.)

General Description.—Built in '88 by a company, both for domestic use and fi protection. Water is taken from springs, by gravity. *Hydrants*, 10. Cost, $15,0

MISSOURI.

LOUISIANA, *Pike Co.* (Pop., 4,325; est., 5,500.) **On Mississippi river**, in B falo township. **Engaged in manufacturing.**

History.—Built in '87-8 and put in operation about Mar. 1, by Louisiana Wa Co., which is controlled by the American Water-Works & Guarantee Co., Ltd., Pit burgh, Pa. Contr. for labor, A. W. Stevens, Logansport, Ind.

Water Supply.—Mississippi river, filtered, pumping through mains to res voir.

Pumping Machinery.—Dy. cap., 2,000,000 galls.: two 1,000,000-gall. Walker pum

Filters.—National, dy. cap. not given.

Reservoir.—Cap., 1,200,000 galls.: **305 ft. above low water in river.**

Distribution.—*Mains*, 12 to 4 in. c. i., 6½ miles. *Services*, galv. i. Pipe and sp ials from National Foundry & Pipe Works, Scottdale, Pa. *Hydrants*, Ludlow, & *Valves*, Ludlow.

Pressure: Ordinary, 80 lbs. Fire, 100 lbs.

Financial.—Cost, about $75,000. Capital stock, $100,000. Hydrant rental, $ each.

Management.—Prest., J. H. Purdy. Secy. and Treas., W. S. Kuhn, Pittsbur Pa. Supt., S. B. Culver.

PIERCE CITY, *Lawrence Co.* (Pop., 1,350; est., 4,000.)

History.—Built in '88 by J. Guinney. Des. Engr., J. W. Nier. Const. Eng S. Jobe. Both of Kansas City. Labor done by the day.

Water Supply.—Guinney's lake, by gravity to stand-pipe.

Stand-Pipe.—Cap., about 100,000 galls.; 15 ft. in diam. by 75 ft. high.

Distribution.—*Mains*, 7 miles. *Hydrants*, 22.

Financial.—Cost, $40,000. Ann. rev.: city, $1,700 for 22 hydrants, or $77.2

Management.—Owner and Supt., J. Guinney. Report by City Clerk, S. Schaen.

NEW MEXICO.

CLAYTON, *Colfax Co.* (Pop., not given.)

General Description.—In May, '88, a newspaper report stated that a rese 120 ft. in diam., walled with stone, was being built, and that pipe would be laid th to a tank, from which water would be pumped to the town. Town Agent, T. S. land. No answers have been received to inquiries sent.

CALIFORNIA.

BAKERSFIELD, *Kern Co.* (Pop., est., 1,500.) **On Kern river, which water-power.**

History.—Built in '83-4 by Bakersfield Water Co., under 50 years' franchise. in operation in Jan., '84. Engr., and Contr., E. C. Arnold.

Water Supply.—Four artesian wells, pumping to tank. There are two two 10-in. wells.

Pumping Machinery.—Dy. cap., 1,000,000 galls.; two Blake pumps.

Tank.—Cap., 33,000 galls.

Distribution.—*Mains*, 6 and 4-in. iron, about 6 miles. *Taps*, 600. *Meters*. *Hydrants*, 13.

Corrections and Additions.

Consumption, 150,000 galls.

Financial.—Cost, $26,000. Capital stock, $50,000. No bonds or debt. Ann. op. exp., $3,500. Ann. rev.: consumers, $5,700; city, none, hydrants being free.

Management.—Prest., and Supt., W. H. Scribner. Secy. and Treas., W. E. Houghton.

SAN ANDREAS, *Calaveras Co.* (Pop., est., 600.)

General Description.—Masterson & Wallace supply the business houses of the village by pumping to tanks, the pumps being driven by a windmill. Est. cost, $1,000.

Corrections and Additions to Classified Reports.

MAINE.

Biddeford and Saco.—For 13,000 taps, read 1,300.

Brunswick.—For 210 meters read 3 meters.

NEW HAMPSHIRE.

Dover.—See p. 13. No further data.

Hanover.—Under conduit, for from '21 to '57, read from '21 to '28.

Lisbon.—Under consumption, for 1,000,000 read 100,000 galls.

Northfield.—See pp. 17 and 18. No further data.

Manchester.—For debt, $600, read debt, $600,000.

Windsor.—General Description of new System: Built in '88 by village. Engr., Geo. H. Leland. Contr. for labor, Jno. T. Langford, Boston.

Water Supply: Dudley brook, by gravity from impounding reservoir.

Reservoir: Cap., 7,000,000 galls.

Distribution.—*Mains*, c. i., 4.6 miles. *Services*, tarred i. Pipe from Donaldson Iron Co., Emaus, Pa., and specials from Davis & Farnum, Waltham, Mass. *Hydrants* Ludlow, 40. *Valves*, Ludlow.

Financial: Cost, not given, but est., $30,000. Bonded debt, $30,000. Int. 5%.

MASSACHUSETTS.

Adams.—History.—Built in '73 by city.

Amesbury.—Reservoirs: For cap. of 2,000,000 and 8,000,000 galls., read 1,500,000 and 500,000 galls. respectively.

Amherst.—History: The Amherst Water Co. recently bought the property of the Pelham Water Co., whose works were built in '83 to supply a part of Amherst.

Boston.—Chestnut Hill Reservoir: For cap. about 700,000 galls., read cap. about 700,000,000 galls.

Bridgewater and East Bridgewater.—Water Supply: Two surface wells in Bridgewater, near Tom river. For Washington pump, read Worthington pump.

Stand-Pipe.—Cap., about 270,000 galls.; 25 ft. in diam. by 75 ft. high, open at top.

Clinton.—Reservoirs: In next to last line, for cap., 25,000 galls., read cap., 2,250,000 galls.

Kingston.—History: From '04 to '88 an Aqueduct Co. supplied water in Kingston. Its works were bought by the city in '88.

Lowell.—Reservoir: For cap., 30,000 galls., read cap., 30,000,000 galls. There is also a high service reservoir, built in '81, having a cap. of 1,324,000 galls. Meters, 1,530.

New Bedford.—Distributing Reservoir: For cap., 16,000 galls., read cap., 15,000,000 galls.

Corrections and Additions.

Salem.—Pumping Machinery: For dy. cap., 5,000 galls., read dy. cap., 5,000,000 galls.

Springfield.—Ludlow Dam: For heart-wall of rubble masonry 333 ft. wide, read do., 3⅓ ft. wide.

Warren.—History: Besides the works owned by the town there is a small system built by the Warren Aqueduct Co., in '37, and another built by the —— Aqueduct Co. in '72.

West Brookfield.—History: In addition to the small works owned by the town there are three other systems. The West Brookfield Aqueduct Co. built works in '38; the Quabacg Aqueduct Co. in '52; and the Cement Aqueduct Co. in '72.

Westfield.—Distributing Reservoir: For cap., 4,530 galls., read cap., 4,530,000 galls.

Distribution: For Mains, w. i., read Mains, c. i.

Financial: For cost, $361,000, read Cost, $261,000. For ann. op. exp., $2,073, read do., $2,037.

CONNECTICUT.

Hartford.—For Settled in 1735, read, do., 1635. For Consumption, 500,000,000 galls., read consumption, 5,000,000 galls.

Naugatuck.—For est. pop., 60,000, read, do., 6,000.

Shelton.—Reservoirs: For first reservoir has a cap. of 50,000 galls., read, do., 50,000,000 galls.

Waterbury.—Reservoirs: In fifth line, for 1,000,000 galls., read 100,000,000 galls.; in sixth line, for ¼ mile, read ⅓ mile.

NEW YORK.

Mount Morris.—History: Built in '79.

NEW JERSEY.

Hoboken.—Filter: National Water Purifying Co.'s aerating plant.
Tanks: The largest is 30 ft. in diam. by 30 ft. high.
Hydrant rental: For Union Town, Weehawken and Guttenburg, $5.

Short Hills.—History: For Stewart Grosscup, read Stewart Hartshorn.

Trenton.—History: In first line, for '88 read '03.

Weehawken.—History: For '33 read '83.

PENNSYLVANIA.

Centralia.—History: Built in '66 7.

Water Supply.—Springs on mountain, by gravity.

Dams and Reservoirs.—Four dams from as many reservoirs. Not further described.

Distribution.—*Mains*, 4-in. c. i., 2-in. galv. i., about 3 miles. *Services*, galv. i. *Taps*, about 260. *Meters* and *Hydrants*, none.

Consumption, about 50,000 galls. *Pressure*: From 125 to 200 ft. head.

Financial.—Cost, $10,000. No debt.

Management.—Prest., Edw. Williams. Secy., Jno. W. Fortner. Treas., A. K. Mensch. Supt., Saml. A. Miller.

Chester.—History: The South Ward works were extended in '68 to supply the whole city, which they did until '88. In '87 the New Chester Water Co. bought the old plant, and made it a part of their system. The Co. also supplies the boroughs of Upland and South Chester, purchasing the old distributing plants in these places.

Reservoir: Cap., 12,000,000, instead of 15,000,000 galls.

Pumping Machinery: The new pumps are two 4,000,000-gall. Holly-Gaskill. There are 5 boilers with a combined cap. of 300 H. P.

Management: For Treas., E. Woltmann, read Treas., Walter Wood.

Corrections and Additions.

Financial: For cost, $4,250,000, read Cost, $1,250,000.

Greensburgh.—See p. 184. No further data.

Lansdale.—History: For built by borough, read built by Lansdale Water Co.

Stand-Pipe: Cap., about 58,000 galls.; 10 ft. in diam. by 100 ft. high.

Capital Stock, $50,000.

Management: Prest., W. D. Heebner. Treas., A. C. Godshall. For Supt., W. D. Heebner, read Supt., T. D. Heebner.

Pittsburgh.—Pumping Machinery: The four engines at the works built in '78 are Lowry, and each drives a 2,000,000-gall. pump.

Reynoldsville.—History: also supplies Horatio. Water Supply: springs, pumping to tanks.

Pumping Machinery: From Jno. Jenks, Brookville.

Tanks: Two, cap., about 36,000 galls. each.

Distribution: *Mains*, 8 to 4-in. c. i., 3½ miles; from R. D. Wood & Co., Philadelphia. *Hydrants*, Mathews, 18. *Valves*, Chapman.

Pressure: about 100 lbs.

Financial Cost, $15,000. Capital stock, from $12,000 to $20,000.

Management: Prest., Fred K. Arnold. Secy., M. M. Davis. Report by Thos. H. Scott and R. B. Thomas.

Selin's Grove.—History: Built in '85-6. Engr., Fred Dittman. Contr., P. Herdic, (deceased). Both of Williamsport.

Water supply: Penn's creek, a mountain stream, pumping to reservoir and direct.

Pumping Machinery: Knowles, dy. cap., not given.

Reservoir: Cap., about 1,000,000 galls.; 180 ft. sq. by 18 ft. deep.

Distribution: *Mains*, iron, 5½ miles. *Services*, galv. i. *Pressure*: Ordinary, 60 to 65 lbs. Fire, 65 to 100 lb.

Financial: Cost, $30,000. Bonded debt, $25,000. Int., 5%. Hydrant rental, $30 each.

VIRGINIA.

Norfolk.—History: Built in '72 by city. Des. Engr., Robt. K. Manning.

Filter: National Water Purifying Co.'s plant.

NORTH CAROLINA.

Goldsborough.—History: Contract for works has been awarded to H. Hungerford, New York City. Franchise is for 30 years. The city will pay $2,790 a year for 52 hydrants. Work to begin by April 1.

OHIO.

Cincinnati.—Eden Park High Service Reservoir: For cap., 1,000,000 galls., read, cap., 100,000,000 galls.

Marion.—Proposed System: The works mentioned on p. 315 were not completed, and Nov. 23, '88, a 25 years' franchise was granted to Howland & Ellis, Boston, Mass. Water will be pumped from filter galleries, alongside Little Scioto river, to a stand-pipe 20 ft. in diam. by 120 ft. high. There will be provision for direct pumping. There will be two 2,500,000-gall. duplex, compound condensing pumps, 11 miles of 16 to 4-in. pipe and 143 fire hydrants. The city will pay $480 per year per mile of pipe, and $390 per mile per year for extensions. Address Howland & Ellis, Boston, Mass.

INDIANA.

Plymouth.—History: For built in '08, read built in '88.

Washington.—History: Put in operation Dec. 15, '88.

Water Supply: White river, pumping to stand-pipe and direct.

Pumping Machinery: Two 1,500,000 gall. Holly-Gaskill pumps; a compound and high-pressure. Boilers from Erie City (Pa.) Iron Works.

Distribution: *Mains*, 12 to 4-in., c. i.; from Lake Shore Foundry, Cleveland, O. Trenching and pipe-laying done by Carroll E. Gray, Jr., Chicago, Ill. *Hydrants*, Ludlow, 91. *Valves*, Ludlow.

Corrections and Additions.

Financial: Capital stock, $100,000. Int. on bonds, 6%.

Management: Prest., H. C. Hodgkins. Secy., F. S. Pecke. Both of Watertown, N. Y. Treas., Frank Watts.

MICHIGAN.

Greenville.—History: Built in '88 by village. Des. Engr., J. B. Davis, Ann Arbor. Const. Engr., G. S. Williams, Saginaw. Labor done by day and by local Contrs.

Water Supply: Driven wells and river, by direct pumping, the river supply being for fire protection, and there being 35 2-in. wells, with 1¼-in. points.

Pumping Machinery: Dy. cap., 1,440,000 galls.; two 720,000-gall. Deane compound duplex pumps, with 10 and 16-in. steam, and 9¼-in. water cylinders of 10-in. stroke. Two 50 H. P. upright Otis steel boilers, made by McGregor Bros., Detroit.

Distribution: *Mains*, 12 to 6-in. c. i., 6 miles. *Services*, lead. Pipe and specials from New Philadelphia (O.) Pipe Works Co., and Detroit Pipe & Foundry Co. *Taps*, about 30. *Meters*, none. *Hydrants*, Ludlow, 45. *Valves*, Flower. *Pressure*: Ordinary, 80 lbs. Fire, 140 lbs.

Financial: Cost, $55,000. Debt, $25,000. Int., 5%.

KANSAS.

Eureka.—History: Const. Engrs., Nier & Mitchell. Contrs., S. K Felton & Co., Omaha.

Water Supply: Fall river, pumping to stand-pipe.

Pumping Machinery: Dy. cap., 1,000,000 galls.; two compound duplex 500,000-gall. Deane pumps. Boilers from Joplin (Mo.) Machine Co.

Stand-Pipe: Cap., 96,000 galls.; 18 ft. in diam. by 50 ft high; from Joplin Machine Co.

Distribution: *Mains*, 10 to 4-in. c. i., 6 miles. Pipe and specials from Ripley & Bronson, St. Louis, Mo. *Hydrants*, Mathews, 33. *Valves*, Chapman. *Pressure*: Ordinary, 75 lbs.

Financial: Cost, $40,000.

NEBRASKA.

Weeping Water.—History: Des. Engr., S. K. Felton. Const. Engr., S. K. Felton & Co., Omaha.

Water Supply: pumping to reservoir, instead of stand-pipe.

Pumping Machinery: A 550,000-gall. Knowles pump.

Reservoir: Cap., about 170,000 galls.; 140 ft. above the main street.

Distribution: *Mains*, 8 to 4-in. c. i., 2 miles. *Taps*, 75. *Meters*, none. *Hydrants*, 13.

Financial: Cost, $15,000. Debt, $13,000. Int., 6%. Ann. op. exp., est., $1,000. Ann. rev.: consumers, $750; city, none.

Management: Comr. and Supt., C. C. Martin. Reports by G. and W. L. S. Neligh.

NOTE: The above data, if conflicting, takes precedence of that given on p. 453.

West Point.—History: Engr., S. K. Felton. Contr., A. L. Strang Co. Both of Omaha.

Water Supply: There are 24 2-in. driven wells, 30 ft. deep, connected at the top.

Pumping Machinery: Dy. cap., 2,016,000 galls.; a 864,000-gall. water-power, and a 1,152,000-gall. steam duplex Knowles pump. The use of power for pumping is leased to the village for $500 a year.

Reservoir: Cap., about 110,000 galls.

Distribution: *Mains*, 10 to 4-in., 4½ miles. *Taps*, about 160. *Meters*, none. *Hydrants*, Ludlow, 35. *Valves*, Ludlow.

Consumption, 200,000 galls. *Pressure*: Fire, 90 to 125 lbs.

TEXAS.

Marshall.—History: To be in operation about April 1, '89.

Pumping Machinery: Dy. cap., 1,500,000 galls.; two 750,000-gall. Deane pumps.

Stand-Pipe: Cap., about 160,000, instead of 23,203 galls.

Corrections and Additions.

Distribution: *Mains*, 10 to 4-in., 9 miles; from Shickle, Harrison & Howard Iron Co., St. Louis, Mo. *Taps*, 82. *Meters*, none. *Hydrants*, Gaskill, 62. *Valves* Holly.

Financial: Cost, $67,000. Bonded debt, $67,000. Int., 6%.

Management: Mayor, Jas. H. Coates. No Supt. appointed.

Note: These details, if conflicting, take precedence of those on p. 485.

COLORADO.

Telluride.—**History:** Built in '86. Des. Engr., H. Corbin, Telluride. Const. Engr., —— Lader.

Water Supply: Creek, by gravity.

Reservoir: Cap., about 140,000 galls.; about 60 ft. in diam. by 7 ft. deep.

Distribution: *Mains*, 6-in. welded w. i. *Services*, w. i. *Pressure*: 180 lbs.

Financial: Cost, not given, but est., $22,000. Bonded debt, $22,000. Int., 8%.

Management: Supt., F. M. Dunlap. Report by J. P. Redick.

CALIFORNIA.

Gilroy.—**Proposed System:** On Jan. 26, '89, the village voted to issue $50,000 of bonds for works; these not to be sold less par, and not to bear more than 5% int. Proposals for bids for the bonds, and for cast-iron pipe had been asked the middle of Feb., '89. Report by B. A. Wardell.

Pomona.—**History:** Built in '82-3, instead of '88.

Distribution: *Mains*, 8½ to 4-in., 30 miles; [probably includes mains for irrigating.] *Taps*, 800. *Hydrants*, 21. *Pressure*: 60 lbs.

Financial: Cost, $100,000. Capital stock, $250,000.

Management: Supt., H. J. Nichols.

NEVADA.

Reno.—Owned by A. A. Evans.

NEW BRUNSWICK.

Saint Andrews.—**Proposed System:** The Chamcook Water Co. have a charter, but nothing will be done until the town makes a hydrant contract with the company. Prest., S. L. Tilley. V. Prest., Robt. S. Gardiner, Boston, Mass. Treas. Eugene F. Fay, Brookline, Mass. Office, 67 Federal St. Boston, Mass.

SUGGESTIONS AS TO A UNIFORM SYSTEM OF REPORTS OF THE ANNUAL OPERATIONS OF WATER-WORKS.

[Made at the Fifth Annual Meeting of the American Water-Works Association, by J. J. R. Croes and Chas. G. Price, Committee on Annual Reports.]

The object aimed at in these suggestions is to secure such a uniformity in the matter and manner of presentation of statistics of general interest that the efficiency of different methods and machines may be compared without too much labor.

A general summary of the condition of the works, and of the progress of construction during the past year, may be first given, particularly noting accidents and the means taken to prevent their recurrence. If any new work has been done it should be particularly described. Recommendations for alterations and extensions may then be made. The plainer and briefer this part of the report is made, the better it will be understood and appreciated by those who examine it for information.

The statistical part of the report should follow, and we recommend its arrangement in the following order. Some of the items may appear unnecessary at first glance, as giving information that the officials and citizens of the town itself are familiar with, but it must be remembered that our object is to inform those who are *not* familiar with the details of the work:

WATER-WORKS REPORT FOR THE YEAR ENDING ....

Name of place ....County, State of ....
Population by census of 1880 ....
Present estimated population ....
Source of supply ....
Mode of supply ....

CONDITION OF DISTRIBUTION.

	ADDED DURING YEAR.	TOTAL TO DATE.
Pipes laid for distribution	ft.	miles.
Service pipes laid	ft.	miles.
No. of houses on streets on which mains are laid		
No. of houses supplied		
No. of individual accounts for water rates		
No. of services in use		
No. of meters on domestic services		
No. of meters on business services		
No. of fire hydrants		
No. of stop-gates on main pipes		

	Gallons.
Daily average quantity of water supplied	
" " used for each tap	
" " metered for domestic use	
" " " " business "	
" " used for public purposes	

MONTHLY CONSUMPTION AND PRESSURE IN BUSINESS PART OF TOWN.

	Gallons Daily	Pounds pressure at 10 A. M.			Pounds pressure at midnight.		
		Greatest	Least	Average	Greatest	Least	Average
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Average							

PUMPING RECORD.

Kind of Engine.......... ....
No. of days pumping.......... ....
Total pumping time......hours.. ..minutes.
Average pumping time per day .....hours......minutes.
Total number of gallons pumped per day.......... ....
Average number of gallons pumped.......... ....
Static head on pumps: feet.......... ....
Dynamic head on pumps, by gauge.......... ....
Pounds of fuel consumed for pumping.......... ....
" " " banking and starting.......... ....
Pounds of fuel used, total.......... ....
Engine duty in pounds of water raised 1 foot high (dynamic) by 100 pounds coal.......... ....
Cost of fuel used.......... $..........
Wages of engineers and firemen.......... $..........
Cost of oil and waste.......... $..........
" " repairs and expenses.......... $..........

Total pumping expense.......... $..........
Cost of raising 1 million gallons 1 foot high (static).......... $..........
Cost of coal per 1,000 lbs.......... $..........
Kind of coal used.......... $..........

FINANCIAL STATEMENTS.

	DURING YEAR.	TOTAL TO DATE.
Cost of Construction..........	$..........	$..........
Bonded debt increased or diminished..........	$..........	$..........

COST OF MAINTENANCE FOR THE YEAR.

Office expenses superintendence and clerks.......... $..........
Superintendence of repairs outside.......... ....
Material and labor for repairs.......... ....
....

PUMPING.

Engineers and firemen.......... ....
Fuel.......... ....
Oil and sundries.......... ....
Ordinary repairs about pumping station.......... ....
$..........

Total Maintenance expenses for year.......... $..........

SUMMARY OF EXPENSES FOR YEAR.

Construction.......... $..........
Interest on debt.......... ....
Maintenance and repairs.......... ....

Total.......... $..........

REVENUE FROM CONSUMERS.

From unmetered domestic taps.......... $..........
" metered " ".......... ....
" unmetered manufacturers' taps.......... ....
" metered " ".......... ....
Misscellaneous sources.......... ....

Total.......... $..........

REVENUE FROM PUBLIC FUNDS.

For hydrants.......... $..........
" street watering.......... ....
" fountains.......... ....
" public buildings.......... ....

Total from public.......... $..........
Total revenue.......... $..........

SUMMARY.

Total receipts.......... $..........
Total expenses.......... ....
Balance paid from public funds.......... ....
Or balance paid into City Treasury.......... ....

DIRECTORY OF WATER-WORKS OFFICIALS, ENGINEERS AND CONTRACTORS.

[The numbers following each name refer to the page on which the name appears.]

PRESIDENTS.

Adams, Frank	300
Adams, J. W.	26
Adkins, Dr. I. L.	420
Ailkin, Robert	164
Alexander, Geo.	72
Allen, O. C.	231
Ambler, B. S.	321 462
Andrews, J. P.	527
Andrews, L. P.	465
Ansley, Hudson	134
Appleton, Thomas	48 61
Archer, B. F.	269
Armstrong, A. H.	519
Armstrong, B. A.	82
Armstrong, Wm.	394
Avery, C. A.	320
Ayraut, Miles	126
Babcock, E. S., Jr.	524
Bacon, Francis	143
Baker, Geo. F.	156
Baker, Henry	442
Bain, Lewis	396
Balch, J. K.	414
Baldwin, F. A.	351
Ballantine, Duncan	91
Banks, R. Lenox	91
Banning, J. B.	532
Bannister, E.	506
Barnes, Jas. M.	471
Barnes, R. W.	335
Barnhart, Wm.	528
Barr, Samuel F.	12
Bassett, C. R.	98
Batchelder, D. J	414
Bott, Anthony	493
Battin, Jas.	152
Beach, G. E.	395 458
Beardsley, A. G.	92
Beauchemin, P.	549
Beers, G. G.	116
Belcher, J. White	56
Belknap, Henry	461
Bennett, A. W.	62
Bennett, J. M.	538
Berney, Wm.	276
Betts, W. W.	177
Benzenberg, Geo. H	399
Bigelow, P.	51
Biggs, J. S.	101
Billings, F. K.	24
Birkbeck, Jos	183
Birnie, Wm.	56 85
Bisbot, W. W.	534
Bitzer, R. R.	182
Black, Alex. G.	464
Black, Alger G	453
Blair, D. C.	149
Blair, J. T.	184
Blakeslee, W. W.	232
Bland, D. W.	219
Bleakie, Robt.	42
Blessing, Jno.	338
Bly, E. H.	455
Boardman, J. M.	270
Boardman, W.	106
Bolles, H. O.	388

Bomowger, Isaac F.	191
Bond, D. W.	53
Bonebrake, J. E.	428
Booth, C. H	82
Borst, M. D.	98
Bourke, Oliver	97
Braches, C.	488
Brackenridge, G. W.	487
Brainaird, Ira D	143
Brandon, W. G.	174
Brevard, Dr. A. J	260
Brewer, F. B.	144
Briggs, Richard F	25
Brightman, Horace	117
Bringham, W. A.	403
Briscoe, Chas. H.	86
Broadhead, S. B.	111
Bronson, L. M.	389
Brooke, Geo.	172
Brooks, I. W.	86
Brown, A.	278
Brown, Chas. H.	38
Brown, J. H	257
Brown, J. L.	178
Brown, Jno. S.	329
Brown, S. W.	506
Brown, Thos.	168
Bruce, D. H.	138
Buchanan, Jno. M	235
Bullit, Wm. C.	257
Bullock, Samuel R.	224 285
Bunker Wm. B.	186
Bunnell, F. C.	229
Burkhard, Joe	508
Burkitt, G. W.	488
Burbage, W. E.	268
Burleigh, Alvin	18
Burnett, Henry	298
Burnham, Jno.	553
Burt, Joel	61
Campbell, Jno. C.	15
Campbell, Jos.	195
Canfield, R. B.	528
Carpenter, C. E.	74
Carpenter, G. B	233
Carr, B. L.	501
Carr, Robt. E.	503
Casanova, J. N	216
Cate, Edw. W.	52
Cather, John	224
Caton, J. D.	383
Cattell, Alex. G.	156
Chamberlain, S	193 410
Chapin, F. L.	58
Chapman, J. G.	465
Chaser, R. Gardner	50
Chrisman, G. W.	524
Clark, D. W.	38
Christensen, P.	499
Clarke, Ezra	79
Clark, W. A.	462
Clark, Julia Mrs	529
Clarke, B. R.	396
Clarke, J. V.	350 551
Clarkson, D. A	161
Clergue, F. H	11

mts.

rn, W. D.		402
att, Ignatius		551
		399
H		551
m. O		469
Noves S.		272
k, Strong		142
M		239
, Jas		397
g, M. W		436
le, Jas. M		114
eo, A		522
eo, H.		159
M.		484
n, D. C		350
O. C		181
Mrs. E		137
W		176
Jno		560
enry E		401
Jas		168
over, H		491
Wm. S. L		83
e, Jno. D		373
Alex		218
S. E		305
R. E.		281
N. M		109
t, A. G.		9
ham, Jno		134
Gaylord		227
n, W. A		11
, David H		63
on, A. O		64
Fred. Jr,		148
, Henry S.		81
st. R. W.		153
, F		508
S. P.		242
on, G. B	412	419
H		278
V. H.		102
son, W. A		26
k, J. W.		280
, Hamilton		227
J. F		263
Jno. S		40
Mark L. M		529
y, H. L		190
Jas. J		255
W.		512
rty, O. R		320
B. D.		92
J. S.		483
, R. V. W		102
, W. C.		191
, J. E.		81
R. W		427
Stephen		19
J. H.		287
Denton W.	311	481
so W.		331
n, E. C		14
L		80
meyer, Rudolph		146
Jno S.		463
F		333
Howard		221
, F A.		479
N. A		437
H		312
F. E.		528
Henry		510
s. C		338
seph		140
P., Jr.		57
rth, H. D.		97
Peter K		130
Henry		301
Chas		336
saac		218
W		517
K		454
E. G		400

Fish, L. B.		489
Fishman, H. F		219
Fisk, Wilbur		315
Fitts, Z. W.		165
Flad, Henry	471	473
Flagler, T. F	392	395
Fleck, Ira S		429
Fontaine, A		545
Foot, Luman.		77
Forbes, A. R		496
Ford, J. B.		228
Forwood, J. L		176
Framm, P.		390
Frazer, Jas. S		340
Frederick, S. S		169
French, R. L		18
Frey, J. W		477
Frick, J. E.		507
Fries, Frank H.		262
Frost, Saml. R		481
Fuller, L. H		83
Fuller, L. T.		479
Funston, Jno. A		173
Gaines, A. B.		476
Gaines, Jas. L		290
Galyert, Bailey		505
Galeno, S. V.		339
Gamble, Jas. M	234	417
Gardiner, J. J.		533
Garrison, D. E		470
Gee, Drr. S. L		83
Geer Seth W.		196
Gill, J. D.		194
Gilman, Chas. J.		3
Gilbert, F. E.		435
Glassmire, A. H.		227
Goodall, E. M		9
Godard, A. A		430
Goodhue C. L.	25	54
Goodhue, C. L.		54
Gorman ,Wm. H		236
Gormly, J. B.		302
Gould, B. T. H.		544
Gracey, F. P.		286
Grant, A. A.		502
Gray, CarrollE		422
Gray, M. L.		486
Green, Chas. D.		162
Green, C. H.		39
Green, J. H.		313
Greendike, J.		514
Griffiths, J. J,		229
Guyer, C.		230
Haas, Jno.		227
Hall, Jno		469
Hall, R. N.		549
Hall, Wm.		161
Hamilton, Alex. W.		342
Hamilton Wm.		350
Hamilton, W. F.		141
Hamlin, Henry		225
Hammond, Stephen H		105
Hancox, H. A.		4
Hand, R. L.		101
Handley, J. A.		430
Hardy, Geo.		145
Harges, C. F.		443
Harper, W.		111
Harris, E. M.		99
Harris, J. L.		540
Hart, Chas.		114
Hastings, Wm.		259
Haupt, F. S.		183
Haunneck, C. C.		269
Hawks, Wm. E.		498
Hayes, Geo. W.		520
Hazard, R. N.		367
Hazzard, H. N.		440
Haglitt, Saml.		231
Heath, G. P.		54
Heesen, Geo.		364
Hellman, H.		484
Heraden, H. C.		264
Higgins, D.		405

Presidents.

Highland, S. M. 398
Hildreth, C. G. 296
Hildreth, S. P. 520
Hill, Chas. 189
Hill, Wm. 521
Hinds, F. A. 93
Hinds, W. W. 334
Hines, Judge 254
Hirst, Jno. W 435
Hobart, F. A. 30
Hobart, G. A. 161
Hobart, W. S. 536
Hodgkins, J. H. 145
Hodgkins, Henry C. 378
Hogan, D. S. 334
Holden, S. E. 518
Hollis, P. C 179
Holman, S. W 261
Holmes, C. M 488
Hood, R. N 288
Hooten, J. G 336
Hopkins, Moses 531
Hopkins, T. E. 78
Hopper, Thos 141
Horn, Caleb 2 2
Horne, Caleb H 232
Horne, W. P. 137
Horner, Chas. 184
Hosmer, Theo 506
Hotchkin, J. L 365
Howland, A. H. 358 388
Howard, Chas. Webb 526
Howell, W. B 107
Howell, Wm. H. 266
Hoyt, J. F 426
Hubbard, C. L. 114
Huff, Geo. F 184
Hull, F. A 299
Hutchinson, A. C 543
Hyman, P. C 536
Ingram, O. H. 394
Irwin, Theo. W 228
Iselin, Adrian 117
Jackson, Alex 416
Jackson, Chas. C 62
Jackson, Henry J. 19
Jackson, M. C 497
Jacobs, F. S 220
Jacobus, D 421
James, Dr. O. P. 179
Jamison, B. K. 235
Jarboe, H. L 499
Jenks, Jeremiah 363
Jermyn, J. J 187
Johnson, W. H. 342
Jones, A. F 530
Jones, B. F 463
Jones, Frank 19
Joy, Moses, Jr 45
Kay, T. M 512
Kelpley, J. J 321
Kennedy, R. S. 198
Keogh, Thos. B 261
Kerndt, M 413
Ketchum, Geo. A. 279
Kiefer, Leopold 320
Kiefer, S 185
Killman, Chas. A. S 155
Kimball, C. H 441
Kimmons, B. F 312
King, Saml. L. 285
Kindred, C. F. 4 1
Kinney, Jno. 359
Kline, A. 198
Klotz, Robt 193
Knowlton, J. C 143
Knowlton, Wm. M 17
Kramer, Henry 99
Kuhn, Jas. S 336
Kuhn, W. S 373 449
Kuhnen, Nicholas 409
Laforge, Ira 162
Laine, O. O 96
Lamb, Chas. A 375
Lamb, Chauncey 408
Lanning, A 337
Lanson, S. C 153
Lapham, E 76
Latham, T. J. 289
Laughton, F. M. 4
Lawrence, Franklin M. 5
Leach, Lewis 514
Lear, Jos 194
Lee, R. H 191
L'Huilier, G. D 411
Leinfelder, J. A 396
Lentz, Geo 273
Lewis, B. W 497
Lewis, Julius 261
Lewis, Weston 5, 6 540
Lindsley, Jas. L 112
Lionberger, Jno. R. 428
Lippincott, Jesse H 198
Litch, F. A 174
Little, H. B 32
Little, Jno. 326
Lockwood, Jno. 107 108 110 130
Long, Dennis 298
Loomis, Chas. E 91
Low, Dr. F. S. 132
Lowesburgh, J. W 130
Lucas, Geo. H. 384
Lukens, Inwood 178
Lynch, J. C 513
Lyon, R. G. 364
Lyon, Thos. R 357
McCane, J. T 99
McClellan, H. W 97
McClallan, W. C 61
McCombs, A. P 212
McConnell, W. C 223
McCormick, A. H. 476
McElma, F. B 295
McGowan, J. O 327
McHenry, R 518
Mack, A 164
McKillip, W. A 243
McKinstry, M. C 242
McKierog, J. M 276
McLane, A. L 486
McM llen, J 186
McMurtry, W. S., Jr 515
McQuillin, J 357
Malin, C. H 460 469
Mamille, R 175
Mansur, W 6
Martin, A. M 101
Mar in, E 395 403
Marvin, G. E 151
Martin, J. M 519
Mason, L. C 496
Masten, W. C 469
Martin A. N 314
Mather, M. D 478
Maynard, G. W 174
Mayo, Dr. E. N 12
Maxwell, G 84
Mellon, A. W 458
Menges, M 401
Metesser, L 282
Myers, A. J 519
Myers, J. D 177
Michell, J 125
Millar, S. C 425
Millar, S. A 295 372
Miller, H. E 538
Miller, S. H 195
Milliken, T. J 362
Mills, M. H 115
Mills, M. W 504
Mills, W. B 495
Millspaugh, J. L 487
Minugh, J. R 163
Mitchell, F. W 183
Moffett, J. F., 107, 116, 311. 318, 380, 392 425
Moore, J. B 357
Morgan, S. B 231
Morris, T. A 332

Presidents.

Morrison, W	468
Morritt, M	326
Morse, C. H	330
Mott, T. S	127
Moulton, J. C	16
Mowery, H. W	105
Mudge, A. B	7
Mudge, B. C	8
Mulrane, J	417
Neubert, V	196
Nichols, B. S	521
Nixon, J. T	156
Norton, D. C	379
Norman, Geo. H	73
North, John G;	523
Norton, J. L	380
Norton, Thos. N	328
Noyes, G. W	21
Noyes, Wm	14
Nye, Jas. K	70
Odenwelder, Saml	197
Oliver, T. J	482
Orchard, A. W	333
Orr, G. C	189
Parkhurst, J. C	391
Parsons, J. F	181
Pascoe, W. F	226
Patrick, J. P	414
Payne, E. D	71
Payson, Chas. H	444
Pebbles, N. H.	319
Peck, E. N	431
Peet, J. B	393
Peloubet, Esten	475
Pendleton, Jas. M	75
Perkins, B. F	12
Perkins, P. B 464	473
Perkins, P. C	335
Perry, J. B	101
Perry, Wm. H	516
Pettebone, S	125
Phelps, Henry	380
Phelps, H. W 394	425
Phillips, H. M	415
Phipps, D. Goffe	87
Piper, Jackson;	243
Pitman, W. M	17
Pitney, H. C	157
Pitt, B. B	274
Plastridge, Amos	22
Plate, Theo	474
Playford	230
Playters Frank	441
Poland, Wm	303
Polhomius, J. A	477
Polk, J. S	410
Pollock, Wm	232
Plume, D. W	84
Porter, E. H	55
Porter, Wm. T	167
Post, Wm. W	291
Prendergast, D. M	485
Purdy, J. H 413	450
Putnam, Henry W	20
Quigley, J. B 428	473
Ramsey, J. B	138
Rand, B. L	139
Rand, Geo. D	406
Randall, J. J	369
Ranney, Willis M	59
Ray, J. G	39
Rees, R R	506
Reese, Jno. P	446
Reeve, W. G	497
Reeves, H T	170
Reichert, Louis P	95
Reynolds, Jno	160
Rickert, Saml	226
Richards, E	470
Ripley, Ebed	41
Robertson, G. W	359
Robinson, E	515
Rochwell, J	45
Rodenbaugh, J. S	180
Rolfe, D. P.	449
Roquemon, Jno. D	277
Rothers, H	340
Royce, C. C	324
Ruhan, F. G	135
Runkle, Daniel 300	431
Ryan, C. J	114
St. John, Ed. K	338
Sanford, H. S	274
Savage, J. B	85
Sawyer, Jos	24
Sawyer, J. L.	144
Scanlan, T. H	484
Scannell, M	321
Schaffner, F. J	187
Schieffelin, E. G	228
Schofield, A. D	273
Schofield, J. S	275
Schwenk, Wm	197
Scoville, J. W	383
Scranton, S. S	78
Scranton, W. W	223
Seager, F. B	421
Palmer, Lorrin	106
Pancoast, M. G	158
Pancoast, Richard	74
Parker, J. W	482
Osborne, Weaver	38
Osler, Van B	242
Shakespeare, Jos. A	281
Shank, J. M	339
Shaw, Jas. G	166
Sevier, S. Q	475
Severy, D	492
Sessions, J. H	77
Seely, W. A	459
Seaton, B. F	414
Search, Geo. W	224
Shaw, L	12
Sheldon, L. A	516
Schellenberg, F. Z	235
Shelton, Nathan 375	376
Shelton, T. W	509
Shepard, F. M	152
Sherman, W. J	490
Shinkle, Amos	294
Shippee, C. W	50
Shirley, Thomas C.	6
Sibby, D. L. L	400
Silliman, E. S	192
Simonds, Andrew	265
Simpson, C. M	502
Skinner, Wm. J	113
Slavson, J. S	512
Slingluff, J	199
Smith, A. H	57
Smith, Draper	218
Smith, F. Hopkinson	102
Smith, G. B	541
Smith, Jno. B.	179
Smith, Jno. J	520
Smith, L. T	437
Smith, O. C	271
Smith, S. C	88
Smith, W. A. C	523
Smyth, Chas. H	98
Snell, Jas. B	91
Snow, Whitney G	157
Souther, C. B	407
Spalding, Edw	17
Spencer, Geo	422
Spivey, R. M	439
Spofford, Parker	11
Spotswood, A. T	442
Sprigg, W. O	241
Stang, Jno	315
Stanley, Jos	501
Starr, Geo. W	182
Starr, W. G	108
Steele, W	150
Steele, W. W	351
Steers, Henry J	71
Stevens, E. E	429
Stocker, L. W	24

Presidents.

Stoddard, E. A 128
Stokes, E. H 160
Storm, Jno. B 226
Storrs, W. R 222
Strobridge, J. H 520
Sutton, Jas. T 129
Swain, A 174
Sweat, Chas 456
Sweet, Edwin F 357
Sweetser, D. H 47
Swentzell, W. M 440
Taintor, Geo. E 116 468
Taylor, B. F 100
Taylor, Emzy 483
Taylor, O. P 319
Taylor, W. H 474
Thomas, Aaron 86
Thomas, J. D 487
Thomas, Saml 162
Thomas, W 521
Thompson, C 448
Thompson, J. F 432, 434 477
Thompson, J. L 438
Thompson, Jas. M 149
Thompson, W. H 500
Thorn, Wm. E 99
Thornton, T. M 387
Thurston, J. W 432
Tibbett, Saml. D 10
Tierce, Henry 519
Tinsman, O 200
Tisdale, Henry 437
Todd, Lemuel 175
Toreger, Jacob 297
Tracy, E 112
Trafton, Jno. B 11
Traver, Wm. H 109
Treman, Leonard 110
Trerett, L. H 369
Trump, Frank 187
Trumpbower, Matthew 135
Turner, A. B 8, 438 451
Twitchell, Homer 80
Underwood, W. A 417
Utter, G. H 504
Vaile, Jno 475
Vanderhurst, W 523
Van Doren, J. L 129
Van Dyck, Peter 135
Van Hise, Isaac A 155
Vincent, W. A 503
Voorhis, Wm 126
Wadsworth, W. A 104
Waldron, David A 72
Walker, R 527
Wallace, A. M 248
Wallace, J. C 195
Wallace, Thos 76
Watsen, Fred 502
Walton, Andrew
Ward, Zeb
Warner, J. W
Warren, W
Washburn, Elmer
Watts, Jos. E
Weaver, H. L
Weaver, Sam
Weis, Albert
Weller, E. M
Wells, E. H
Welsh, C. A
Welton, Nelson J
Wemyss, R. J
Westcott, C. T
Westcott, Geo. P
Westcott, Munro
Wheat, B
Wheeler, E. D
Wheeler, Harvey
Wheeler, H. C
White, E. A
White, Jno
White, Wm. H
Wilbur, E. P
Wilcox, G. E
Wilcox, H. R
Wilcox, J. W
Wiley, S. L 26, 27, 324, 341, 351
Wilkins, W. L
Wilkinson, J. M
Williams, D. R
Williams, E
Williams, I. F
Williams, J. J
Williams, L
Wilson, R. F
Wilson, Thos. J
Winner, W. E
Wise, Alfred
Wistar, I. J
Woltmann, E 283, 305, 316, 325, 332, 402.
Wood, Geo. M
Wood, W. D
Woolsey, W. C
Woolston, Geo. F
Wooster, Wm. B
Worstall, Geo. C
Wyckoff, V. Z
Yengling, G. F
Young, F. M
Young, J. R
Young, Mason
Young, Stephen J
Zehnder, C. H
Zeller, D. K
Zeller, Jos

SUPERINTENDENTS.

Abell, Geo. M 101
Adams, Anthony 85
Adams, A. S 42
Adams, Jas 537
Adams, Wesley 519
Aldersley, Ed 311
Aldrich, A. J 380
Allen, A 509
Allen, G. E 114
Allen, Henry E 105
Allen, H. W 522
Allen, Jas. L 515
Allen, W. H 464
Alexander, Henry 265
Allis, Solon M 47
Alstrulund, Fred 381
Ambrose, F. W 324
Andrews, M. L 428
Andrews, R. N 313
Andrews, W. G 458
Augier, G. W
Anthony, C. F
Armstrong, A. B
Armstrong, Edward
Armstrong, F
Armstrong, F. C
Armstrong, Milton
Aylward, Jno
Bagnell, R. W
Bailey, D. A. B
Baillarge, S
Baker, B. F
Baker, Chas
Baker, Henry
Baker, T. E
Balch, J. K
Ballantine, David
Ballou, C. A
Barcus, W. J
Bardell, John F

Superintendents.

Barnes, A. S	450
Barnes, F. B	400
Barnes, R. W	335
Barnes, M. F	59
Barker, W. H.	418
Barnet, Jno.	333
Barney, Wm. H	50
Barns, Everett	75
Barry, D. C	481
Barstow, C. D	397
Bartholomew, D	76
Bartlett, C. L	464
Barton, T. B	588
Bartram, I. N	84
Basem, R. W	441
Bassett, E. M.	98
Bassett, G. G	418
Bassett, Jno	490
Bassett, Philip J. H	151
Bates, S. D	191
Battle, J. W	366
Baughman, Chas. H	243
Bayley, F. A	542
Beals, Jos. E	49
Bechtel, I. P	229
Beebe, W. D	458
Beers, G. G	116
Bell, Jas. A	560
Bell, Dr. L. S	242
Bemus, J. E	492
Benishek, A	359
Bennett, C. E	138
Bennett, Jno. A	10
Bennett, J. M	538
Bennett, Jos	344
Bennett, Nelson	86
Bennett, S. A	77
Bennett, Wm	268
Berriman, Peter	388
Berry, J. W	187
Bevan, Saml	227
Bevey, T. H	475
Borst, Jas. N	98
Biays, W. H.	429
Bierbower, Wm	360
Bigelow, A. D	462
Bigler, H. F	177
Birdsall, F. W	511
Birely, S. M	242
Bishop, Justus	169
Bixby, W. A	375
Blaine, O. P	462
Blake, B. W	279
Blakeslee, W. W	232
Bliss, C. E.	531
Bliss, Geo. F	534
Blump, Philo. B	97
Blythe, Saml. H	104
Boardman, A. E	268 270
Bodder, Chas.	172
Boeckh, Ed	413
Bolling, C. E	254
Boon, J. B	255
Bowen, M. C	228
Bowen, Wm.	417
Bowman, Jerome F	506
Boyce, R. B	27
Boyd, Thos. E	164
Boynton, D. C	129
Brackett, Dexter	30
Brady, Jno. G	69
Bradley, Given W	481
Bragden, H. G	96
Branch, Geo. C.	115
Brand, Junius A	83
Brandon, Melvin H	114
Brigden, W. W	343
Bridge, Henry	349
Brigham, Perry	230
Brinsmade, D. S	84
Broatch, J. C	80
Bronson, S. E	397
Brooks, J	112
Brown, Geo. W	217 499
Brown, J. E	518
Brown, Milton, A	161
Brown, M. T	489
Bruce, D. H.	138
Brundage, Wm. H	278
Bryan, Chas. F	259
Bryan, J	497
Buchanan, J. J	111
Buck, Robt	231
Buckley, Ralph	194
Buckram, Geo. A. P	54
Bull, Wm. B	386
Bullis, H. P.	496
Bunker, Theo	395
Bunn, A. B	162
Burchill, Alex	539
Burke, Jas	282
Burnett, Muscoe	298
Burnham, Albert D	56
Burt, R	35
Burtch, Frank H	103
Bush, J. W	451
Butler, Chas. S	495
Byer, H	338
Cadwalader, Chas	522
Cady, Jno. R	362
Cahill, S. A	357
Calderwood, Chas. A	23
Caldwell, M. O	135
Cameron, W. L	289
Campbell, Donald F	364
Campbell, J. H	273
Campbell, L. C	376
Campbell, Simon.	187
Canfield, A. W.	528
Cannon, S. M	489
Carbet, Dr	556
Carpenter, G. W.	91
Carpenter, W	454
Carson, J. M.	372
Carter, Edw. C	556
Casper, Chas. W	163
Caton, J. D	383
Cattell, Alex. G	156
Chadbourn, E. J	41 56
Chadwick, W. B	339
Chaffee, J. C	44
Chamberlain, A. E.	36
Chamberlain, Martin.	131
Chambers, John T.	514
Chandler, Geo. H	356
Chapin, F. L	58
Chapin, Geo. L	45
Charles, S. A	296
Chase, F	15
Chase, H. S	14
Chase, J. C	263
Cheney, E. L	16
Chete, F. P	290
Chew, T. J., Jr	471
Chrisman, G. R	509
Clark, D	186
Clark, D. M	312
Clark, Ezra	79
Clark, F. T	91
Clark, Geo	143
Clark, J. M	53
Clewell, B. F	232
Cochran, R. L.	50
Cochran, S. R.	184
Cockburn, W. D	402
Codd, Wm. F	50
Coe, H. C	508
Coe, L. E	426
Coffin, G. H.	148
Coffin, H. W	536
Coffin, Isaac T	513
Coggeshall, Robt. C. P.	52
Cole, Ira	142
Coleman, G. H	254
Collins, J. W	265
Conant, H. W.	39
Conant, Whitney	156
Conaway, G. T	[illegible]

Superintendents.

Cone, I. M. 239
Connell, E. W. 333
Cook, J. S. 443
Cooke, J. B. 516
Coon, C. P. 395
Cooper, Geo. F. 326
Corley, Jno. R. 485
Cortlett, Robt. 181
Cotter, H. 324
Cotter, Jno. A. 483
Courand, T. M. 479
Covell, L. T. 57
Cowell, T. 412
Cox, John L. 541
Craig, Wm. 422
Cramer, C. H. 159
Crandall, F. H. 21
Crawford, J. A. 507
Craycroft, E. 337
Croft, T. T. 396
Crosscup, Geo. E. 163
Crossman, A. F. 199
Crowley, Fred 481
Criley, P. F. 68
Cullum, Geo. S. 104
Culver, B. E. 88
Cummings, S. E. 384
Cunliffe, L. H. 104
Cunningham, E. R. 469
Cunningham, Jno. 134
Cunningham, J. M. 180
Cunningham, W. B. 501
Cunningham, W. W. 258
Currier, Orlando 6
Curtis, E. A. 104
Curtis, F. M. 337
Cuttle, Francis 523
Daggy, J. L. 331
Dale, Frank 182
Davidson, Jas. 493
Davidson, Joel S. 360
Dane, Wm. 65
Darling, Edwin 73
Davis, E. J. 439
Davis, E. K. 430
Davis, Ed. O. 438
Davis, E. R. 469
Davis, F. A. W. 332
Davis, J. M. 22
Davis, W. E. 136
Davis, Wm. M. 22
Dayton, Jno. 180
Deane, Wm. 305
Depuy, Geo. 172
Dennis, W. A. 142
Denny, C. P. 469
Deschamps, L. 356
Deyer, M. 341
Dieffenbaugh, C. H. 230
Diehl, C. H. 66
Dixon, Wm. 359
Dobson, M. 200
Donald, Mark, L. M. 529
Dorn, G. W. 512
Dotten, Wm. T. 67
Doty, D. 385
Douglas, A. J. 490
Douglas, H. F. 151
Dowd, Thos. 160
Doyle, F. P. 521
Duff, J. W. 8
Duggan, Jas. A. 390
Duke, W. H. 528
Dunbar, E. L. 343
Duncan, Dan S. 224
Duncan, J. S. 342
Dunlap, Jno. B. 80
Dunmeyer, Wm. 230
Dunn, Wm. A. 157
Eason, W. E. 20
Eastabrook, E. R. 108
Eastman, Saml. E. 189
Eaton, C. A. 80
Eaton, Chas. H. 309
Edmonds, Jos. A. 468
Eldred, N. B. 92
Elliott, Chas. 526
Ellis, E. H. 130
Ellis, Geo. 449
Ellis, R. N. 272
Ellis, W. F. 260
Elmer, Howard 221
Engelhard, E. B. 261
English, H. 220
Escoff, Jas. 192
Evans, H. E. 10
Evans, I. P. 318
Ewer, Seneca 523
Fairbank, Wm. G. 78
Fales, Henry M. 139
Falls, B. R. 393
Farnam, J. B. 34
Fasig, Wm. B. 177
Fassett, A. L. 145
Felter, D. 93
Ferguson, F. D. 389
Ferguson, Jno. 529
Ferrier, Wm. E. 178
Fillman, Josiah 221
Fish, J. B. 222
Fisher, C. H. 4
Fisher, C. I. 10
Fisher, Lewis 314
Fisher, M. M. 335
Fitts, G. B. 27
Fitzgerald, Desmond 30
Fitzpatrick, W. F. 249
Flanagan, W. M. 376
Flood, Ira A. 430
Foge, A. S. 325
Fogle, C. A. 262
Forbes, F. F. 32
Ford, Jno. E. 439
Forrest, W. T. 504
Foss, H. W. 501
Foster, Joel 21, 24
Fowler, Chas. E. 131
Fox, C. J. 107
Freed, S. L. 179
Freeman, E. J. 415
Freeman, Geo. H. 8
French, Melvin C. 43
Friend, Jno. G. 279
Frierson, A. S. 262
Friesleben, D. N. 520
Fritts, W. A. 474
Frost, Edw. W. 493
Fry, D. C. 377
Fuller, E. L. 479
Fuller, L. T. 479
Fyler, O. R. 86
Galley, S. A. 169
Galleges, Juan 517
Gamble, Jno. 558
Gamewell, J. H. 54
Gardner, L. H. 284
Gardiner, J. M. 533
Gariety, J. A. 545
Gatchell, Thos. K. 265
Gates, A. R. 462
Gay, F. D. 406
Gaylord, N. J. 357
Gee, Decatur 96
Genest, Ludger 545
Gerlich, Gustav 486
Gilbert, David 448
Gilbert, J. C. 58
Glashan, T. M. W. 486
Glove, W. H. 292
Glover, C. M. 415
Glover, C. W. 466
Goodrich, Geo. A. 406
Goodrich, H. P. 16
Goodwin, J. A. 5
Gordon, F. M. 1
Gorman, W. H. 236
Gow, R. M. 49
Graham, A. R. 453

Superintendents.

Gramsley, H	369
Grannis, S. F	81
Graves, J. D	415
Graves, Saml. S	105
Graves, Wm	508
Gray, G. R	159
Gray, Theo. W	422
Greene, F. L	440
Greenfield, J	19
Greenlee, E. G	393
Greenman, J. M	420
Grier, T. J	455
Griffin, Jno. D	295
Griffin, Jno. F	192
Griffith, J. C	405
Griffith, W. H	387
Griffiths, J. J	229
Grindle, A. H	3
Gross, A	438
Grow, C. A	531
Grush, B. S	57
Guernsey, A. D	412
Guernsey, Geo. A	174
Guy, Jas. P	544
H as, A. F	341
Hailey, J. S	410
Hailey, R. T	485
Halback, J	189
Hall, C. F	355
Hall, Chas. S	399
Hall, T. E	55
Hall, Wm. M	86
Hallison, Geo. A	150
Hamel, O. Z	549
Hamilton, Alex. W	342
Hamilton, Jas	179
Hamilton, Johnson	137
Hamilton, Wilson S	327
Hancock, J. C	60
Hand, Frank L	202
Hanley, P. M	411
Hanna, R. J	183
Hard, V. G	155
Hardenock, Jos	170
Hardsall, J. T	145
Hardy, Jno. D	41
Harmes, G. R	291
Harper, A. G	476
Harper, L	458
Harper, Wm. B	220
Harrigan, H. J	36
Harrington, Geo. W	63
Harrington, W. K	395
Harris, D. A	81
Harris, G. J	247
Harris, W. T	287
Harrison, Ward	172
Harvey, Barney	97
Harvey, Robert	488
Haskins, Wm	553
Hastings, S	437
Hastings, V. C	13
Hatch, J. M	55
Haven, Edw	486
Hawkins, H. A	372
Hawkins, Robt	377
Hay, J. J	484
Hayden, Chas. T	134
Hayes, Jno	392
Hayes, W. K	441
Hazen, Jas. W	24
Hazelton, E. J	396
Healey, J. C	67
Heermans, H. C	100
Heim, Jno. B	397
Hellwig, A. A	105
Helm, Alfred	534
Henderson, Thos	329
Henderson, Wilson	558
Henneberg, Chas	103
Henrouex, P. L	548
Henry, Chas. F	233
Hermany, Chas	296 297
Hess, J. H	440
Hess, S. D	224
Hewett, T	554
Hewlett, H. N	360
Higgins, H. W	83
Highlands, H. H	336
Hill, Albert F	73
Hill, Wm. J	37
Hinds, W. W	334
Hinshaw, Geo. W	263
Hoeflich, Jno. R	232
Holden, H. G	17
Holland, J. F	6
Hollenberger, J. M	242
Holman, S. W	261
Holmes, A. L	351 499
Holmes, Jos. B	249
Holmes, Richard	494
Honck, Albert	442
Hooper, Thos N	409
Hoover, Jos	329
Hopewell, J. C	152
Hopkins, J. M	382 383
Horner, F. M	373
Horton, E. S	505
Hotchkiss, C. M	145
Howard, P. R	411
Howell, W. H	509
Hubner, W. D	190
Hudler, Alfred	112
Hughes, H. B	224
Hughes, W	500
Humphrey, L. H	177
Hunt, A. B	451
Hunt, Wm	323
Hutchings, W. S	187
Hutchison, D. P	260
Hyde, Jr., Nelson F	52
Ingels, C. B	469
Inman, A. W	321
Irish, P. E	26
Irwin, N. C	464
Jackson, F. W	383
Jackson, H. B	523
Jackson, H. K	31
Jacobus, D	421
Jenness, A. K	6
Jeremy, R. W	432
Johnson, Chas. H	14
Johnson, J. G	514
Johnson, Shalen W	176
Johnston, W. A	190
Jones, A. F	540
Jones, B. F	468
Jones, M. E	278
Jones, Omar O	413
Jones, R. A	505
Josel, F. E	375
Joslin, A	319
Joyce, A. K	174
Joyce, Geo	170
Judson, Chas. A	321
Kalback, Jno. F	172
Karr, J	459
Keating, E. H	541 542
Keeler, S	185
Keirns, T. H	77
Kellogg, Clark	340
Kellogg, R. C	101
Kelly, H	317
Kennedy, O. H	443
Kent, A. F	111
Kent, Willard	75
Kern, J	358
Kerr, H. E	453
Kiefer, L	329
Kiernan, Patrick	38
Kinch, S. B	430
King, James	541
King, Jno. D	198
King, J. H	149
Kimball, Geo	496
Kimball, J. F	457

Superintendents.

Kingsley, S. L. 3
Kinley, Wm. L. 289
Kinney, E. C. 461
Kittredge, Wm. C. 229
Knapp, L. H. 96
Knifer, A. T. 99
Koch, H. G. 491
Koenig, F. 515
Koons, C. W. 317
Kountz, R. F. 399
Kress, W. C. 282
Krieger, A. H. 184
Krueger, H. 382
Krusen, W. J. 497
Kuhn, Wm. 197
La Barre, S. E. 419
Lacey, Jas. 455
La Flenn, W. H. 350
Laforest, Pierre 545
Lakin, Jno. T. 356
Lamb, Warren 99
Lambert, R. 554
Lamorent, W. O. 402
Lance, O. M. 218
Landis, B. J. 224
Lane, C. J. 173
Larrabee, S. L. 5
Lautz, H. 384
Lavilette, G. 559
Lawton, E. 314
Lawton, E. A. 300
Ley, Hi. 534
Leatherwood, R. N. 534
Ledlie, J. H. 479
Lefevre, J. Z. 127
Lehman, B. H. 226
Leonard, Francis 83
Leonard, Francis 83
Lewis, Chas. T. 465
Lillie, S. J. 456
Linderman, Dell 511
Linton, W. H. 320
Lockwood, Jos. A. 146
Lockwood, C. A. 102
Loder, Orrin J. 129
Long, B. J. 316
Long, Jas. 458
Long, Jno. T. 255
Loomis, D. H. 144
Loomis, G. T. 91
Lord, A. H. 426
Lott, Jeremiah 103
Loughlin, Frank M. 384
Lovell, Thomas C. 38
Low, F. S., Dr. 132
Lowe, H. H. 85
Lyman, H. H. 127
Ludwig, Carl 512
Lyon, Jas. W. 401
Maybury, W. E. 358
Mc Alpine, A. H. 310
Mc Callum, A. W. 316
Mc Caune, D. J. 497
Mc Clintock, G. L. 236
Mc Connell, B. D.—Acting 547
Mc Culloch, R. 266
Mc Cusker, Jno. E. 30 52
Mc Dougal, D. 361
Mc Dowell, Felix 228
Mc Farland, C. A. 186
Mc Farland, C. R. 263
Mc Garry, Roger 233
Mc Grath, A. C. 176
Mc Guire, H. P. 508
Mc Henry, R. 518
Mc Ilvaine, E. S. 156
Mc Intosh, Alex. 457
Mc Intyre, A. W. 346
Mc Kenzie, T. H. 85
Mc Kinnon, W. 266
Mc Martin, J. A. 350
Mc Minn, J. H. 234
Mc Mullen, W. 175
Mc Pike, A. J. 531
Mc Williams, J. A. 505
Madden, D. N. 530
Manchester, Geo. L. 37
Manning, C. F. 241
Mansfield, L. K. 78
Mansfield, S. A. F. 30
Marsh, Jno. J. 53
Martien, C. H. 458
Martin, A. C. 139
Martin, S. E. 59
Martin, Benj. B. 75
Martin, C. F. 361
Martin, H. C. 394
Martin, H. P. 298
Martin, J. M. 510
Martine, A. H. 383
Maslin, J. W. 242
Mason, L. C. 436
Mason, Marshall 22
Mattes, Jos. 417
Maxwell, E. N. 477
May, Emmanuel 549
Melheany, C. A. 315
Mellon, W. H. 222
Mensinger, H. A. 529
Mentzer, S. C. 326
Mercer, E. P. 188
Meredith, Reuben T. 157
Meredith, W. B. 174, 189 331
Merrill, E. W. 199
Merrill, Parker 49
Messenger, H. C. 433
Messer, Oliver 406
Meyer, Geo. S. 392
Middlemist, J. 101
Miller, Alvin N. 270
Miller, B. J. 465
Miller, C. A. 227
Miller, F. M. 260
Miller, J. K. 403
Miller, W. C. 117
Mills, Albert J. 559
Mills, D. J. 517
Milner, W. S. 279
Mines, W. W. 151
Mitchell, Jno. 480
Mitchell, Richard 542
Mizner, E. A. 512
Molis, W. 416
Monroe, E. 361
Montegel, J. M., Jr. 341
Montgomery, J. J. 480
Moore, Arthur G. 301, 305 309
Moriarty, D. D. 181
Morris, E. H. 142
Morrison, W. O. 424
Morrow, C. C. 455
Morse, C. W. 40
Morse, J. W. 51
Morse, W. B. 363
Morton, B. R. 298
Moulton, H. S. 88
Moor, I. 549
Mulhelland, Wm. 516
Munger, L. C. 504
Munro, D. 540
Munson, Geo. 177
Murdock, Gilbert 540
Myrick, W. S. 382
Nash, J. F. 7
Nason, Wm. E. 30
Nelson, N. 269
Nelson, S. L. 369
Nesbit, J. J. 437
Nettleton, Chas. H. 77
Nevons, Hiram 33
Noble, Jno. T. 363
Noble, Thos. J. 432
Norris, Jas. H. 93
Norris, J. L. 100
Norris, Jno. W. 514
Norton, T. A. 127

Superintendents.

Nulton, Jno. H.	256
Nyce, Geo. W.	495
Oakley, E. C.	76
O'Brien, M	443
O'Brien, Patrick	184
O'Connor, M	149
Ohlinger, Louis B.	303
Owen, Jas	157
Olcott, Geo. P.	152
O'Leary, C.	255
Oliver, T. J.	482
O'Lone, Wm.	182
O'Neil, Jas. A	433
Opp, Geo. B.	283
Osborne, D. B.	434
Ottinger, G. M.	538
Ottman, Louis	114
Overton, Jno. B., 426	536
Page, I. P.	251
Painter, Jno L	302
Palmer, W. K	441
Parish, H. G.	382
Parker, T. R	518
Parrot, E. D	507
Parsons, J. F	181
Patrick, Jno.	558
Patterson, Wm. S.	436
Patton, Jno. Jr.	223
Paul, E. S	374
Paul, Mifflin	163
Paulison, Wm	160
Payne, I. W	89
Payne, L. C.	16
Pease, A. G.	59
Peatt, W.	141
Peck, E. H	431
Peck, L. C.	7
Peck, O. A	21
Perkins, S. H.	64
Pettegrew, S. C	439
Pettis, E. G	339
Pettit, R.	488
Peyton, Geo	256
Phelps, J. W.	102
Philbin, J. F.	43
Phillips, Fred	226
Phinney, Jno. W	61
Phipps, E. H	87
Pickett, Chas	27
Pierce, F. H	503
Pingree, Job	537
Pinkham, G. B	538
Pitman, Lycurgus	17
Pollard, Kendall 48	61
Pooley, W. C	392
Pope, Geo. A	550
Porter, Benj.	355
Porter, F. F	340
Potter, W. A	425
Potter, Z	326
Powell, Robt	505
Power, Francis	247
Price, J. C.	395
Price, Philip M	144
Priddy, C. N	498
Prince, Geo. T	148
Privett, D. J	279
Purcell, Chas	519
Putnam, C. M	101
Putnam, E. H	20
Qua, Ransom	103
Quimby, Geo. H	325
Quinn, Ed. Gale	274
Quinn, S. J	248
Quint, M. N	54
Rader, R. P	180
Ramsey, Chas. E	175
Ramsey, J. W	170
Ramsey, W. R	174
Rankin, W. A	318
Ratz, Chas. E	219
Reade, J. W 392	400
Reardon, Wm	359
Reaves, Robt	223
Reed, J. C	300
Reed, Thos. J	200
Reed, Wm. S	379
Reiff, Chas. F	313
Renkawitz, Jno	335
Reyer, Geo	290
Reynolds, Fred C	115
Rhodes, L. G	532
Rice, E. C	457
Rich, Danl.	441
Richards, W. G	267
Richards, W. H	82
Richardson, A. B	301
Richardson, Geo.	77
Richardson, J. H	360
Richardson, L. J. 100	108
Richardson, W. T	447
Richmond, G. S	361
Richmond, Lemuel	24
Richtmeyer, B. F	516
Rickert, Saml	226
Ricks, H. L	514
Riddle, Jas. H	259
Riddle, Taylor	438
Ridson, H. C	158
Ries, Geo. J	67
Ring, I. Alfred	539
Ring, T. G.	99
Ringle, Philip	403
Ritchie, Wm. E	130
Robbins, J. H.	509
Roberts, H	20
Roberts, J. M	92
Robertson, A. H	473
Robertson, Geo. H.	544
Robertson, Geo. Y	128
Robinson, E. J	224
Robinson, E. W.	440
Rogers, H. W 5, 10	540
Rogers, Jno. D	134
Rogers, W. E	342
Rollins, A. M	516
Roof, F. O.	502
Rose, W. R	56
Rosenow, C. B	496
Rosse, S. F	473
Roullier, G. A	103
Rowley, E. J	367
Rowley, H. W	461
Royer, Hiram	218
Rudgers, J. W.	357
Rudiger, E. A	449
Rudisill, H. B	276
Rutel, Jno	295
Ryan, Saml. D	171
Ryle, Wm	161
Rynear, L	160
Sabin, Geo	114
St. John, J. W	142
Salisbury, A	143
Salisbury, A. H	44
Salyer, Don A	339
Sanford, Chas. G	67
Sanford, Wm. C	442
Saunders, W. J	129
Sawyer, D. H	15
Schaffer, J. M	258
Schackelford, R. M	530
Schaeffer, August	297
Schefold, F	336
Schroer, Wm	334
Schrof, Ira S	338
Schwartz, Miller	179
Scott, E W	519
Scott, J. H	498
Scott, Jas. M	281
Scott, T	197
Seager, G. E	132
Sears, Wm. H	383
Seaton, G. H	230
Seen, J. D	325
Seifort, Andrew	194

Superintendents,

Sekell, A. C	367
Sener, J. M	248
Serviss, Gordon	553
Seward, E. B	508
Seymour, C. W. S	41
Seymour, Patrick	137
Shamp, H. B	394
Shanahan, W. E	240
Sharp & Sons	319
Sharpe, C. D	83
Sheaff, E. A	116
Shenston, T. M	551
Shepard, Fred	76
Shepard, Mr	453
Sherman, S	96
Shields, G. A	501
Shilling, Jesse, Jr	324
Shirk, R. J	191
Sibley, Frank C	356
Sidner, Wm	153
Sill, A. N	476
Silliman, E. J	192
Simmons, J. L	520
Simpson, B. V	427
Simpson, I. H	4
Singley, L. N	232
Sipp, Geo. H	354
Skinner I. A	520
Slater, E. A	470
Slaw, I. C	166
Slaymaker, S. E	227
Slingluff, J	199
Slocum, W. S	73
Smith, Brooke	479
Smith, Dorsey B	302
Smith, Frank P	97
Smith, G. Parker	542
Smith, Israel W	510
Smith, J. Harper	164
Smith, L. D	387
Smith, M	459
Smith, Solan F	39
Smith, W. R	322
Snow, E. J	300
Snow, F. A	447
Snow, W. W	108
Snyder, J. W	468
Soup, R. M	327
Southard, Henry	216
Sparks, F. E	3
Spinner, Chas. C	107
Spooner, Ed. E	386
Sprigg, W. O	241
Stacey, F. A	303
Stack, J. D	315
Stacy, Geo. A	48
Stafford, Morris T	387
Stalter, Jos	522
Stambough, S. A	344
Stanley, O. G	62
Steele, Jno. H	18
Steele, Jno. M	150
Sternberg, J. M	361
Stetson, C. J	502
Stevens, Chas. B	318
Stevens, E. E	429
Stevens, Jos	416
Stickney, E. R	34
Still, N. S	340
Storer, C. M	145
Storey, G. H	333
Stratton, D. W	42
Streator, C. W	425
Strickland, Jas	551
Strong, C. H	484
Stryker, Geo G	162
Swain, A. C	517
Sweet, S. Van R	129
Sweinhart, Jeremiah	173
Taggle, M. H	269
Tate, A	393
Taylor, A	166
Taylor, C. A	396
Taylor, E. E	483
Taylor, J. W	196
Taylor, T. A	366
Taylor, Wm	99
Tenney, J. G	45
Thayer, F. D	186
Thayer, Wm. F	14
Thomas, C. O	345
Thomas, E. A	475
Thomas, Geo. S	197
Thomas, Howard	408
Thomas, R. B	176
Thomas, Robt. J	47
Thomas, R. L	180
Thomas, W. R	175
Thompson, Saml. S	169
Thompson, W. P	477
Thresher, M. S	529
Thurston, S. D	515
Tichenor, Dave	481
Tight, Chas	313
Tilghman, Wickert	181
Tillinghast, S. W	361
Tinsman, O	200
Todd, W. V	281
Teutelotte, M. L	66
Tower, D. N	35
Tracy, Thos. H	584
Trask, F. E	520
Treman, E. M	110
Troy, J. W	458
Trull, W. E	424
Trump, E. D	187
Tubbs, Geo. L	109
Turner, C. L	432
Turner, Fremont	416
Turner, Jas	431
Turner, J. H	463
Turner, Rob't	559
Turner, T. D	432
Ulrich, J	487
Van, Jno. A	299
Vanatta, A. J	144
Vanderslice, A. S	216
Van Hise, Isaac A	155
Vanlue, Jno	443
Vanuzee, C. A	106
Van Wie, Chas	93
Vaughan, Isaac C	21
Vaughn, W. H	64
Vennum, Jno. F	457
Vick, W. L	470
Vicker, T. S	396
Vliet, Danl	165
Volk, F. A	63
Voorhis, Wm. L	126
Wagner, Jacob	322
Wagnon, A	435
Wagner, L. J	270
Walden, Danl	47
Waldron, L. R	372
Walker, Chas. K	17
Walker, H. O	497
Walker, R	527
Walker, R. H	278
Walker, T. S	483
Walker, Wm. P	380
Wall, J. J	419
Wallace, J. J	377
Walter, Wm	425
Wanner, Lew	331
Ward, Zeb. Jr	476
Warde, Seymour J	117
Warner, H. O	82
Warner, J. W	127
Warren, C. C	22
Waters, C. A	25
Watson, C. H	390
Watson, Jno	389
Wattles, J. D	307
Watts, W. H	482
Weaver, R. F	325
Weber, E. H	396

Superintendent.

Weitmyer, Jno. H	185
Welch, F. A.	456
Welch, Jas. W.	508
Welsh, Wm. J.	30
Welliver, G. W	173
Weldon, Nolsen J.	87
Westcott, Gee. P	8
Westcott, Nelson.	534
Whalen, Jno. B.	389
Wheeler, Elbert.	78
Wheeler, H	394
Wheeler, N. J.	409
Wheeler, Wm.	490
Whelan, Wm	152
Whitback, Frank	456
White, A.	531
White, D. A.	336
White, F. C.	165
White, R. M.	428
Whitney, Geo E.	85
Whitney, H. W.	27
Whittemore, Walter P.	53
Wickham, T. A.	228
Wilcox, J. W	270
Wilson, G. E.	488
Wicks, R. L.	478
Wicks, W. B.	57
Wigal, Jas. P.	295
Wilcox, Wibur	526
Wiley, C. T.	40
Willard, J. P.	403
Williams, D. D	107
Williams, D. I	241
Williams, D. S.	102
Williams, Jas.	188
Williams, J. M	192
Williams, W. H	2
Williamson, L. L.	338
Wilken, W. A	406
Wilkinson, Jas H	292
Wills, E. S.	428
Wilson, Asa,	240
Wilson, H. G	301
Wilson, R. F,	196
Wing, G.	513
Winn, Jno. 93	107
Winne, W. H	110
Winslow, Geo. E	63
Winslow, S. J	18
Wintler, J. R	506
Wires, E. L.	45
Wirt, R. D.	466
Wolf, H. C.	223
Wood, Chas.	406
Wood, Chas. W.	84
Woodman, Frank.	257
Woodruff, Timothy.	150
Woodsworth, R.	418
Wright, A. H	25
Wright, R. A	435
Wright, W. S	356
Wynne, J. S	275
Yates, R. R.	54
Yeaton, J. H	273
York, Jno. L.	451
Zachery, R. Y.	253
Zehner, W. D	190

SECRETARIES.

Adams, C D	320
Allen, H. E.	93
Allen, W. J	275
Anderson J. W	517
Andersen, R. L	273
Anderton, Geo	281
Andrews, F. S	197
Andrews, L. P	428
Andrews, R. N	313
Angier, G. W	228
Anthony, C. F	72
Ar enbright, Newton	255
Armstrong, H. B	145
Armstrong, Henry	378
Ashley, Edw	97
Atherton, H. F	222
Avery, Lewis	362
Bailey, Geo	269
Bailey, Vernum A	73
Baker, H. F	538
Baker, Jas	442
Baldwin, C. H	432
Baldwin, W. D	570
Bangs, E. D	26
Bard, R. A	540
Bardwell, H. D.	62
Barnes, L. C	471
Barry, Bryan T	481
Barshinger, A	375
Bartholomew, D	76
Barton, H. B	76
Bassett, E. M 91, 93	98
Beardsall, W	274
Beebe, L. A	435
Beecher, H. A	388
Bechtel, I. P	229
Bell, E. T	160
Bell, L. S	506
Benedict, H. E	242
Bennett, C. E	138
Bennett, H. G	520
Berkey, J. B	337
Berrian, C. M 283, 332	340
Beggett, E. W	170
Bigler, H. F	177
Billmeyer, Frank P	173
Bin er, Wm	263
Birely, S. M	242
Birnie, T. M	389
Bisbee, Edw. B	19
Bissell, S. S	143
Blair, Jas. K	490
Blake, Paul	198
Blinn, R. F	323
Bloom, W. H	234
Blythe, Saml. H	104
Booth, N. N	191
Bostwick, H. W	183
Bourgeois, L. E	545
Bowen, Wm	417
Branch, Geo. C	115
Brewer, R	412
Brice, I. N	324
Broatch, J. C	80
Broeksmit, J. C.	407
Brooks, Chas	473
Brooks, Geo	570
Brown, C. K	101
Brown, J. N	479
Bryden, A. A	218
Bently, Geo. G	97
Blackman, F. J	106
Blum, Philo B. Jr	97
Brinsmade, D, S	84
Bruyn, C. D	112
Burke, J	554
Buckley, Danl. J	483
Bulkney, N. T	78
Burnell, G. W	400
Burnham, F. W	422
Burritt, D. B	560
Burwitz, O. K	488
Butler, J. S	138
Button, M. F	105
Butts, H. D	443
Camp, A. H	83
Canfield, A. W	558
Carroll, D	523
Carscaddan, J	416
Caton, C. A	383

Secretaries.

Catton, H. R. 527
Caulfield, Jno 426
Chamberlain, J. W 218
Chamberlain, Martin 131
Chamberlayne, J. K 141
Chapman, E. C 83
Chase, J. Seymour 79
Chase, P. B 317
Church, G. M 266
Churchill, C. W 359
Churchill, E. S 518
Clark, D. M 312
Clark, J. C 117
Clark, N. H 199
Clark, Wm. H 166
Clark, W. W 435
Clarke, Ben S 448
Clarke, J. V 425
Clift, T. 543
Clinard, S. M 262
Cochran, Saml 384
Codd, Wm. F 50
Collier, J. M 514
Collman, O. J 446
Conant, Whitney 156
Cone, M. I 239
Conklin, A. R. 515
Conkling, J. G 436
Conrads, C. A 474
Cooley, Wm. V 155
Cooper, A. R 297
Cooper, J. B 166
Corley, Jno. R 485
Cornell, W. T 114
Corscot, Jno 397
Cortlett, J. J. 181
Costar, W. J 512
Cowell, T 412
Cowell, T. E. 419
Cox, E. J 516
Cox, H. E 528
Craighead, J. B 337
Crane, S. H 109
Crane, W. H. 130
Cross, Chas 321
Crow, W. H. B 538
Crozier, H. S 327
Cruft, J. W 338
Crysler, C. S 466
Cunningham, E. R 469
Cunningham, O. P. 11
Cunningham, W. B. 501
Currier, Orlando 6
Cushman, H. D 364
Dana S. A 519
Daniel, T. F 315
Daniels Frank K 229
Davis, Jno. D 428
Davis, M. M 581
Davis, Saml. D 155
Davis, Zimmerman 265
Dawson, Wm. R. 228
Deane, Sidney 71
Decker, J. H 444
Demarest, B. B 102
Denman, A. N 410
Denny, C. P. 469
Dewy, F. H 114
D'Huiller, G. L 102
Dickinson, T. P 575
Diehl, J. W 130
Diven, J. M 569
Dodge, G. E 401
Dodge, J. F 396
Dole, H. N. P 511 365
Donahue, Jas. P 409
Donigan, B. E. 12
Douglass, W. B 456
Douty, F. S 529
Dowe, M. P 78
Downes, F. W 403
Doyle, F. P 521
Drinkwater, J. H 500
Dunbar, E. L 343
Dunn, A. W 131
Dunwell, F. P 357
Durant, W. C 350
Duryea, D. W 305
Dutcher, F. J 59
Eastabrook, E. R. 108
Eastman, Saml. C. 189
Eaton, C. A 80
Eaton, Chas. H 309
Eoy, S. G 232
Eddy, S. A 77
Eden, G. C 564
Egan, M. 527
Egerton, L 175
Eldred, N. B 92
Elford, A. B. 564
Elliott, Geo. 163
Ellis, W. F., Jr 277
Espy, B. M 233
Evans, Fred. W 543
Ewer, F. S 523
Ewing, C. T 430
Eyler, H 429
Farnsworth, H. M 302
Farr, Edw. L 571
Fecke, F. S 107
Felt, J. P 181
Fendall, T. E 247
Feraud, Fulton G 522
Ferguson, J 436
Ferguson, Mrs. Jno 529
Ferguson, S. W 145
Field, Paul 303
Finlay, Jno 282
Fisher, Chas. H. 4
Fisher, R. J 285
Fisk, Thos. E 14
Fitch, G. W 142
Fitts, W. C 281
Fletcher, D. A 414
Fletcher, H. B. 483
Flint, Joseph A 524
Flood, Jas. E 134
Floyd, J. B 144
Foote, Ellsworth I 81
Forbes, A. R 496
Ford, Edgar W 357
Foreman, Wm 492
Fortner, Jno. W 580
Foster, D. P 114
Foster, E. P. 524
Foster, H 504
Foster, J. A 479
Fox, Geo. H 196 331
Francis, J. T 117
Franklin, R. S. 73
Frazee, L. C. 517
Frick, H. R 196
Frost, C. L 318
Fry, A. C 507
Fry, Miss F. B 371
Fuller, E. F. 311 339
Gamble, Fred 96
Gaughan, T. J 475
Gardiner, J. M 533
Gardiner, S. W 414
George, C. H 567
Gerhard, H. E 255
Getchell, W. H 422
Gilbert, A 438
Gillespie, W 137
Gilligan H. M. 411
Goff, J. M 441
Goryas, A. B 421
Gosser, J. J 181
Graham, W. I 430
Green, Chas. E 156
Greene, F. L 440 477
Gregory, A. K 110 130
Grinnell, Wm 320
Gross, J. F 563
Guy, Jas. P 544

Secretaries.

Hafeniere, J. O		545
Haight, S. W		403
Hall, C. L		469
Hall, E. S		156
Hall, J. B	268	270
Hammond, J. C		84
Hand, Geo. B		223
Handy, D. C		236
Hungary, Ed		336
Harder, Geo. D		98
Harding, Henry		229
Harding, H. H		464
Harlow, Geo R		96
Harmes, G. R		291
Harris, W. T		287
Harrison, H. H		427
Hart, G. A		357
Hassen, H. C		380
Haupt, J		183
Havill, O. H		421
Hawley, C. F		95
Hayes, W. K		441
Hays, O. L		313
Hazleton, E. J		396
Heath, H. M		11
Heath, R. W		534
Healy, W. C		221
Helsell, W. A		417
Hemphill, Jno. W		228
Herbig, Chas. A		311
Hershey, B. H		193
Hewlett, E. M		492
Hewson, J. H		415
Hicks, R. S		85
Highlands, S. M	283, 319	373
Hill, Arthur Edmund		566
Hill, H. C		530
Hildreth, C. G		314
Hindekoper, E		194
Hinshaw, Geo. W		263
Hiscock, C. E		342
Hobart, M. P		325
Hobart, N. P	285	402
Hodgkins, H. C		551
Hoffman, Adam		310
Holden, A. R		108
Holland, A. B		475
Holland, Jas. Frank		6
Hollingworth, G. S		292
Holmes, C. M		488
Holmes, Jas. T		488
Holmes, H. S		112
Holmes, Richard		495
Honeyman, A. V. D		164
Houghton, J. H		506
Houghton, W. E		579
How, Geo. G		438
Hubbell, Fred, B		261
Huber, A. H		243
Hudson, A. H		353
Hughes, Alex		455
Hunt, Geo		56
Hunter, Jno. F		239
Hussey, E. F		9
Hutchings, W. S		187
Hutchinson, D. P		260
Immil, D. N		326
Ingall, G. W		51
Irwin, H. I		416
Irwin, Wm. E		216
Jenks, B		363
Johnson, A		273
Johnson, Jno		423
Johnston, W. A		190
Jones, A. N		437
Jones, J. A		438
Jordon, R. S		549
Joslin, A		319
Kear, Chas. R		196
Keeler, F. D		576
Kellogg, R. C		101
Kendlehart, J. W		184
Kennedy, F. C		24
Kent, C. W		159
Kerr, J. C		290
Kershow, J. H		235
Kimball, Chas. E		151
Kimball, D. A		60
Kimball, N. W		410
Kindle, R. W		490
King, Jno. H		149
Kingsland, Edw		105
Kinnon, Wm. M		577
Kleiderer, Fred		295
Knowlton, M. L		458
Kopp, A. C		303
Koss, Louis, Jr		521
Kuhn, W. S	398, 402, 413, 450	458
Kunkle, Frank		197
Laidley, W. S		257
Lamson, D. L		6
Larrabee, Seth L		5
Lautz, Henry		384
Law, Thos		169
Layton, Jacob M		85
L'Huillier, G. D		116
Libby, Prof., W., Jr		162
Linn, W. G		418
Loomis, C. R		459
Loomis, Geo. F		91
Lovell, C. E		395
Ludwig, Carl		512
Lyman, H. H		127
Lynch, Frank		227
McConnel, H. S		198
McCoy, Gen., F. F		191
McCreery, H. C		493
McCue, W		417
McDowell, Geo		225
McFarland, J. W		565
McGiffe, T. F		492
McGuire, W. W		508
McHenry, Ora		518
McKenzie, T. H		85
McLean, Duncan		544
McNamee, J. L		99
McNeil, C. L		86
McNutt, H. M		276
Macrae, B. W		288
McRae, P. E		184
McReady, Jas		226
Madigan, Jno		101
Madison, W. A		308
Maguire, J. A		440
Maguire, J. M		367
Maguire, J. W	387, 433, 449	464
Martin, J. M		510
Martin, R		485
Martin, T. F		502
Martin, W. D. J		174
Mariz, Geo. O		223
Mason, D. N		299
Mason, R. H		274
Mason, W. B. R		149
Mathews, Chas		562
Matlock, G. S		191
Maxcy, Josiah		540
Maxwell, J. H		218
Mead, Wm. H		519
Melheaney, C. A		315
Menzies, G. V		335
Mercer, A. G		143
Meredith, W. B	174, 189	231
Meyer, Geo. S		292
Meyers, J. E		519
Miller, C. A		227
Miller, H. G		219
Miller, Johnson		191
Miller, P		109
Miller, T. DeWitt		125
Miller, W. H		176
Milner, W. J		277
Miller, Wm. C		117
Miznier, E. A		512
Moffett, C. F	116, 192	400
Monk, W		553

Secretaries.
Moody, M 578
Morgan, A. A 115
Morgan, E 111
Morgan, G. S 442
Morgan, J 301
Morgan, Jno. A 83
Morris, E. H 142
Morris, M. A 382
Morrison, A. R 88
Morrison, E 178 316
Morsalis, T. L 482
Morse, D. P 462
Morse, W. B 363
Mould, H. M 111
Moyer, Geo. S 222
Mott, S. H 516
Muirkheid, Jno. J 161
Mullins, R. F 102
Myers, J. K 570
Nelson, S. L 369
Neville, A. C 395
Newman, L. M 394
Newton, H. M 349
Newton, Wm 401
Nice, S. F 390
Nichols, F. B 484
Norbett, W. G 388
Norris, Wm 526
Norton, W. G 380
Noyes, G. W 21
O'Brien, M 443
Painter, M. D 520
Palmer, C. J 118
Palmer, F. L 521
Park, W. J 497
Parker, E. F 394
Parmley, Henry 192
Parsons, G. C 318
Payson, E. R 8
Pearson, W. K 405
Peck, E. H 431
Peck, W. S 429
Pecke, F. S 582
Phillips, H. C 24
Phillips, Sidney A 59
Philson, S. B 195
Pierson, E 157
Pitman, Lycurgus 17
Polhomius, F. M 477
Pollard, W. D 219
Priddy, C. N 493
Prince, Geo. T 148
Proctor, T. A 529
Quinn, Ed. Gale 274
Race, C. H 429
Raeder, F. W 369
Ramsey, Chas. E 175
Rankin, C. A 176
Raupt, Geo 477
Raymond, H. S 375
Reagan, G. L 172
Reardon, Wm 359
Reid, C 563
Reinecke, W 295, 298, 372, 392 395
Rentz, Frank 170
Repp, Jno. S 242
Rettery, Wm 315
Rhodes, Ben. J 125
Rhodes, D. H 435
Richards, Jos. L 179
Richardson, J. H 360
Rieke, L. M 298
Ridson, H. C 158
Roads, J. O 224
Robbins, H. F 40
Robbins, Saml. K 571
Robert, H 550
Robinson, J. F 509
Robinson, Jno 195
Rogers, W. E 342
Ross, J. F 326
Rowland, B. W 489
Rowley, H. W 461
Runkle, Wm 380
Rupert, L. M 414
Rust, F. A 481
Ryan, Jas 96
Sackett, Orange 92
Sager, Jno. J 164
St. John, A. Pope 279
St. John, S. W 280
Salliday, W. B 226
Salmon, C. B 388
Santee, T. M 186
Savage, Chas. P 179
Schenk, A 465, 473 474
Schilcher, F 183
Schloter, E. P 326
Scott, Jas. R 108
Scott, S. S 89
Seager, G. E 133
Searles, N. N 312
Sechler, H. S 199
Segur, D 324
Seward, E. B 508
Shallcrass, A. C 185
Shanahan, Wm. E 240
Sharpe, C. A 330 384
Shay, Wm. F 251
Shenston, T. M 551
Shepard, Fred 75
Shepard, F. M. Jr 152
Sherwood, S. M 136
Shippen, Wm 158
Shurtleff, Jno. T 20
Shuttleworth, L. J 137
Simmons, C. E 383
Simpkins, D. N 327
Simpson, E. S 329
Simpson, Lawrence 270
Singley, L. W 232
Sipe, Geo. L 336
Siple, W. H 187
Slater E. A 470
Slauson, James 512
Slaymaker, S. E 227
Sledge, C. L 444
Sloan, B. F 163
Small, S 54
Smiley, J. C 320
Smith, Chas. H 125
Smith, Ed 479
Smith, Geo. P 130 302
Smith, H. B 339
Smith, S. S 198
Smith, W. K 399
Smith, W. R 322
Smith, W. S 499
Spinner, Chas. C 107
Spockman, Isaac 177
Sprigg, W. O 241
Squires, Geo. C 422
Stake, Edw 241
Stark, Henry 349
Starr, H. C 360
Steben, B. F 551
Stetson, W. W 536
Stevens, A. A 230 498
Stevenson Wm 221
Stevenson, W. L 331
Steward, G. H 506
Stewart, Jas 127
Stickney, E. R 34
Stiger, W. E 431
Strickler, J. N 432
Sturges, Henry 504
Sutton, D. W 366
Sweet, Van R 129
Sykes, E. T 425
Sylvanus T. R 376
Taylor, Harry 236
Taylor, Lee M 488
Taylor, T. A 351
Terry, G. W. Jr 267
Thomas, C. O 345
Thomas, J. R 514

Secretaries.

Thomas, M. W	240
Thompton, Fred	450
Tingley, C. E	45
Tomay, S. C	243
Torns, J. E	179
Torrance, David	77
Traenmer, Geo. P	399
Treadway, C. S	77
Treman, E. M	110
Trotten, J. G	415
Ulrich, J	487
Valentine, D. A	430
Vanatta, J. K	493
Van Liew, E. S	365
Voorhis, A. M	126
Waddingham, W. J	520
Wait, H. O	134
Walker, Edwin B	135
Walker, Jno. M	437
Walker, R. H	483
Ward, H. C	388
Ward, L. B	254
Ward, Zeb, Jr	476
Waterhouse, E. F	549
Waters, L. A	574
Watts, ——	318
Watts, C	543
Watts, Frank	380
Wells, N. A	195
Weems, R. N	468
Wentworth, Jas	468
Weston, J. C	408
Wharton, J. R	462
White, H. D	490
White, J. B	278
White, R. M	428
White, T. F	484
Whiteman, Horace	192
Whittaker, W	497
Wickes, D. L	478
Wickham, T. A	228
Wiley, K. N	341
Wilkinson, H. P	259
Willard, S. J	425
Williams, A. S	576
Williams, L. H	198
Williard, H	126
Willman, Alex	538
Wilson, E. P	437
Wilson, G. W	531
Wilson, H. G	301
Wing, Fred	463
Wing, G	513
Winn, N	475
Winter, C. E	369
Wintyen, Wm. J	179
Wirt, R. M	185
Withers, G. G	500
Woltmann, E	224, 481
Wood, Horatio D	465
Woodruff, W. T	86
Woolworth, Eugene B	98
Worthington, S. K	95
Yocom, I	129
Young, E. B	278
Young, F. C	501
Zearing, I. N	301
Zeidler, Richard E	305
Zeiller, Chas	242

MANAGERS.

Ayers, Sylvanus, Jr	149
Bates, Saml	142
Biebe, L. A	435
Bell Jas. A	559
Birkinbine, Harry	408
Clarke, Ben. S	448
Cove, Alfred	463
Covis, Geo. M	12
Decker, J. H	444
Devereux, J. H	491
Dickinson, Wm. G	518
Dorsey, J. J	515
Dow, Matthew	479
Dresser, H. J	56
Evans, Fred. W	543
Gretham, H. W	273
Harris, J. L	540
Harrison, H. H	427
Haskill, James	231
Haupt, F. S	183
Hilburn, M. H	482
Holmes, C. M	488
Horton, E. S	505
Howland, A. H	277
Hunt, Chas. W	117
Irwin N. C	464
Knowles, W. W., & Son	485
Kuhn, W. S	177, 258, 283, 353, 335
Mather, Mason W	496
Merrill, F. B	96
Miller, Saml. A	298
Millpaugh, J. L	487
Mountain, H. O	501
Mudge, Alex. B	8
Mudge, B. C	10, 11, 31, 39
Page, E. S	21
Parker, L. J	557
Parsons, E. B	229
Payson, H. M. & Co	3
Prouty & Miller	22
Ray, J. S	299
Redington, R. J	229
Rhodes, D. H	435
Richardson, J. S	560
Scannell, M	321
Sekell, A. C	357
Shackelford, R. M	530
Smith, Frank	232
Spencer, C. G	269
Steben, B. F	551
Stephens, B. F	320
Surtees, Robt	557
Trotten, J. G	415
Wiley, S. L	451

ENGINEERS.

[Includes Designing, Constructing, and Consulting Engineers.]

Abbott, E. A	345
Abbott, E. L	388
Adams, Julius W	81, 94
Alexander, Geo	7, 8, 9, 10, 31, 39
Alexander, E. S	375, 384
Alexander, M. J	257
Allan, Donald	255
Allardt, G. F	518
Allen, Jas	255
Allen, Jas. W	149
Allen Kenneth	434
Allen, W. F	115, 431
Alves, Gaston M	295
Alvord, J. W	379
Ambrose, Wm	511
American Gas & Water Pipe Co	165
Anderson, Hugh	373
Anderson, Jas	263
Anderton, Geo. P	281
Andrews, Jas. P	395
Andrews, J. W	263
Andrews, L. P	465

Engineers.

Anthony, Geo. W 374
Arbuckle, F. P 498
Archer, Jas 498
Archibald, A. L 542
Armstrong, A. H 519
Armstrong, Alex 377
Arnold, D. M 188
Atkinson, Roger P. 262
Augur, E. P. 78
Avery, Wm. H 362
Ayers, H. W 77, 79
Babcock, Stephen E 91
Bacon, Jno. W 78
Baermann, Palmer H. 99, 111, 112, 125, 132, 135, 140, 144
Bailey, Geo. H 82, 158, 162, 540
Bailey, H. P 542
Baillarge, S 547
Baldwin, Geo. R. 547
Ball, Phineas 15, 26, 31, 58, 55, 59, 68, 112, 113
Ballou, C. A 248
Barbour Jos. E 508
Barclay, Frank 444
Barnes, R. D 77
Barrett, Jno 509
Barrett, J. M 480
Barrett, W. S 79
Barstow, C. D 194
Barstow, E. C 397
Barton, Herbert B 73, 74, 76
Bassett, Bros 91, 98, 106, 129
Basset, M E 228
Bates, Moses 55
Bates Thos. K 64
Bates, J. Walker 281, 285
Battin, L. B 155
Baum J. W 269
Baxter, F. K 97, 107
Baxter, J.R 107
Beach, G. E 409, 422, 424
Beall, Nelson 241
Beandry, J. A. Y. 548
Beardsall, W 274
Beauchemin & Sons 549
Beech. Chas. D. 278
Béique, J. B. A 548
Belcher, J. E 558
Bell, Jas. 354
Bell, James A 555, 560
Bell, Jas. E 557
Bement, R. B. C 421
Benford G. L 195
Bennett, A. W 62
Bennett, Wm 355
Benzenberg, Geo. H 399
Betts, Arthur L 109, 135
Betts, A. S 108, 128
Betts, B. F 139
Bevan, Saml 227
Bigouy, A. J 191
Bird, Henry 253
Birdsall, F. D 511
Birdsall, Geo. W 48, 122
Birkinbine & Trotter 207
Birkinbine, Harry 408
Birkinbine, H. P. M. 151, 152, 156, 169, 173, 175, 182, 183, 185, 190, 197, 199, 338, 367, 408
Birkinbine, Jno 199
Bishop, Geo. H. 36, 47, 61, 80
Blake, Percy M. 9, 13, 27, 36, 48, 49, 53, 54, 57, 62
Blackie, B. S 289
Blaisdell, Hiram W 35
Blake, C. H. M 72
Blake, Geo. F. Mfg. Co 22
Bliss, H. I 396
Bloomfield, H 509
Boardman, A. E 268, 269, 272, 274, 280
Boardman, W. F 516, 519
Boeckh, Chas 281
Bogue, V. G 460
Bolton, Ed. D 260
Bolyer, T. O 553, 554
Bond, Jos. A. 167
Bond, Richard 248
Bonnett, Wm. W 53
Boothby, W. F 519
Bott, Anthony 498
Bourne, Jno. D. 159
Bouscaren, Geo. 292, 294
Boutelle, T. N. 405, 406, 411, 414, 415, 465
Bowditch, E. W 50, 247, 269
Boyce, W. C. 42
Boyd, J. Edward 539
Brackenridge, C. S 330
Brandon, Geo 113
Branley, Jno. 188
Brigden, W. W 342
Briggs, Geo 354
Briggs, Geo.A 37, 51
Briggs, J. G 376, 363
Briggs, R. E 489
Briggs, V. B 375
Brinkerhoof, Jno 326
Brinsmade, D, 84
Brown, Arthur 520
Brown, F. E 522
Brown, J. B. 14
Brown, Jas. H 218
Brown, M. T 489
Brown, W. C 387
Brown, Wm. M 75
Brundige, Wm. H 278
Brunson, Ira P. 400
Brush, Chas. B 153
Bryan, J. 497
Buckman, O. H. 518
Burgin, J. F 82
Burlingame, F. H 262
Burlingame, O. 358
Burnham, Wm. H. 405, 410, 412, 416, 419, 434
Burns, Jos 429
Buss, Edw. A 58
Butler, C. Y 502
Butler, W. P 454
Buttrick & Wheeler 58
Byrne, A. T 138
Caldwell, Chas 105, 117, 142
Canfield, A. W 527
Canfield, R. B 527
Carson, J. M 372
Cartwright, Robt 193
Casey, J. F 138
Cassin, Isaac S. 110, 148, 149, 150, 151, 155, 156, 163, 165, 166, 169, 172, 177, 178, 179, 186, 194, 200, 216, 218, 231, 233, 240, 314.
Chabot, Anthony 519
Chaffer, Geo 519
Chamberlain, A 88
Chamberlain, A. B 80
Chandler, Prof. C. F 89
Chandler, Geo. H 356
Chapman, Jos. P 265
Chapman, W. S. 508
Chappell, Delas A 501
Charles, S. A 296
Chase, E. C 41
Chase, J. C 263
Chase, K. D 421
Chase. —— 509
Chaurnette, E. N 545
Chesbrough, E. S 28, 217, 377
Chesbrough, I. C 89
Chete, F. P 290
Chipman, Willis 551, 562
Church, Benj. S 119
Clark, C. H 538
Clarke, B. R 7, 320, 396, 438, 462
Clarke, Ben. S 448
Clarkson, D. A 161
Cloud, J. A 149
Coats, W. R 344, 361, 376, 408, 527, 526
Cobb & Stribling 334
Cochran, A. B 196, 223
Coffee, Geo 535

Engineers.

Coffin, Freeman C 544
Coggeshall, Robt C. P 52
Colburne, B. B 455
Cole, Jno. A 378 379
Collins, Noyes S 272
Colt, Griffith 512
Connor, W. C 488
Converse, M. J 481
Cooke, E. C 323, 392 417
Cooke, J. B 513
Cook, J. D 148, 295, 296, 309, 312, 315 317
318, 319, 320, 322, 323, 324, 328, 330, 332 334
336, 341, 354, 361, 374, 450, 451, 481, 483.
Cook, T. F 166
Cooper, F. W 552
Cooper, W. S 529
Corbyn, K. P 372
Corbyn, R. P 421
Corkish, Jno 509 538
Corley, Jno. R 485
Cornelius, Geo. O 230
Courand, J 479
Coverdale & Weir 313
Covert, H. M 524
Cowan, Geo. N 108 145
Cowell, P 405
Cowell, I. E 412, 415 419
Crafts & Forbes 539 540
Craig, Wm 421
Cram, Geo. W 82
Craven, Alfred W 267
Craven, Henry S 119
Crawford, J. A 507
Crawford, S. P 386
Christopher, Collis 118
Croasdale, W. J 539
Croes, J. J. R 84, 117, 155, 162 189
Culver, J 536
Cronimus, Geo 298
Crook, Ewd. D 242
Cullen, Robt 534
Culver, Jno. P 533
Cummings, E. B 234
Curtis, E. A 132
Curtis, Jos. H 63
Curtis, W. W 381
Cushing, J. T 407
Dana, S. A 518
Danforth, F 5
Daniel, Travers 277, 286, 297 414
Darrach, C. G 162 235
Davenport, Col. E. R 257, 327 459
Davidson, A. H 267 268
Davis & Worthington 439
Davis, Chester B 356, 359, 365, 373 385
389, 397, 410, 415, 450.
Davis, E. C 59 65
Davis, Geo. P 45
Davis, Jos. P 28 119
Davis, Preston 528
Day, A. R 153
De Kinder, J. J 189
Delafield, C 273, 283, 316 339
Dennis, H. G 4, 8 10
Dennis, J. H 331
Deurstan, Jas 345
de Varona, J. M 90
Dezeng, W. D 194
Ditmar, — 368
Dittman, J 273
Dorn, E 513
Dougherty, Chas 456
Doughty, Thos. N 81 159
Douglas, E. A 193
Drake & Orton 430 435
Dunbar, E. L 343
Dunham, H. F 320, 358 388
Dunham & Paine 319
Dunlap, J. C 519
Dupras, Evengeliste 559
Drinkwater, J. H 499
Earl, W. H 497
Earnshaw, Henry 333, 334 338

Eastman, Jas. H 159
Edeburn & Cooper 223 325
Edington, Jno 539
Edwards, Jas. P 356
Elbert, Elias 327
Ellerbeck, Thos. W 537
Elliott, — 418
Ellis, Geo. A 260 402
Ellis, J. W 75
Ellis, N. W. & Co 13, 15, 16 18
Elliott, C. D 26
Elliott, Chas 256
Emack, Jno. D 225
Emigh, J. H 109
Enright, Jos 523
Erdman, F 185, 189 247
Ernst, Maj., O. H 144
Esten, S. H 15
Evans, Geo. E 45 462
Evans, Harry 324
Evans, Jno 93
Fairbanks, — 416
Fairbanks, Chas. R 541
Fairbanks, Morse & Co 317, 367, 374 416
432, 459.
Fankisley, Wm 431
Fanning, J. T 16, 22, 82, 83, 87 426
Farney, Jno. H 279
Farnum, H. H 130
Farrington, J. A 18 19
Felton, T. W 446
Felton, S. K 416, 447, 451 452
Ferris & Halladay 155
Ferris, E. G 392, 393, 397, 398 400
Ferris, Garwood 260
Ferry, W. M 537
Field, Alfred R 40
Finley, Jas 152
Fitz, Jno 330
Flanders, J. P 23
Flannery, Jos 198 300
Flannigan, T. J 530
Flinn, Richard J 32
Flint, Walling & Co 362
Forbes, Arthur W 6, 72, 541 542
Ford, J. E 441
Forsberg, A 250
Foster, Jos 21 24
Foster, J. T 389
Fowler, Charles E 128 138
Fox, J. M 531
Franklin, W. F 116
Franklin, W. M. S 112
Franklin, W. S 136
Freeman, C. L 200
Freeman, W. R 489 490
Freeman, W. W 486
Fritts, W. A 473
Frizzell, Wm 492
Frosbee, Julius 113
Fry, P 518
Fteley, A 28, 29 119
Fuertes, E. A 100
Fuller, Allen J 202
Fuller, E. F 176, 284, 288, 298, 305, 332
339, 340, 481.
Fuller, F. D 63
Fuller, F. L 64
Fuller, [illegible] T 479
Gaskill, H. F 132 551
Gatt, Jno 555
Gay, Chas. W 58
George, Jno. A 325
Gerecke, F. W 372
Gerlich, G 486
Geyelin, Emile 156
Gibbes, F. A 512
Glover, E. F 393
Godder, S. V 225
Goff, J. B. H 252
Goodhue & Birnie 388
Goodhue, C. L 54, 66 326
Goodman, Thos. J 334

Engineers.

Gordon, B. B. 276
Gould, M. A. 381
Gowing, E. H. 9
Granger, A. O. 548
Grant, Jno. A. 266
Graves, E. 148
Gray Bros 455
Gray, Carroll E 421, 422 497
Gray, Saml. M 79
Gregg, D. L. 430
Greene, Chas. E 342
Greene, D. M 100, 114, 139 266
Greene, Geo. S. 120, 121 146
Greene, H. H. 356
Greene, H. N. 344
Grosscup, — 478
Guernsey, A D. 412
Guilford, Simeon 190
Hailey, R. T 485
Hale, Walter 70
Hall, Thos. V 475
Hall, Wm 516
Hamein, B. D 225
Hamilton, Jno 517
Hammett, E. A 61
Hanck, A. D 432
Handy, H. P 495
Hare, E. F 523
Harling, J 361
Harlow, Geo. R 96
Harlow, J. C 317
Harlow, Jas. H 190, 194, 198, 227 232
Harris, Geo 184
Harris, Geo. W 241
Harris, R. W. 481
Harris, T. Wm 24
Harris, W. B 59
Harrison, H. H. 395, 424, 426 427
Hastings, Jos 253
Hatch & Taylor 192
Hawley, J. B 426
Hawley, W. C 95 373
Hayne, — 488
Haynes, M. B 423
Heald, S. C 56, 58, 59 67
Hedeman, H. E 484
Heermans, H. C 232
Hem, Jno. Jr. 558
Hermany, Chas 291, 294, 296 297
Henderson, — 560
Henderson, Jno. M 337
Heron, D. C 480
Heron, G. C 480, 483 489
Herschel, Clemens 27 68
Hess, Alex. W 526
Hess, J. H 440
Hewiett, H. N 360
Hicks, H. R 262
Highlands, S. M 283
Hilbert, H. J 397
Hill, Chas. W 435, 440 443
Hill, Jno. W 257, 258 312
Hilts, J. E 442
Hinsdale, Wm. E 333, 376 407
Hinsdale, W. R 104
Hinshaw, Geo. W 263
Hoar, J. A 71
Hodgkins, Henry C 318
Hogan, Peter 165, 133, 140 143
Holly, Birdsall 292, 333, 355 386
Holly Byron 115
Holly Mfg. Co., 110, 135, 137, 178, 240 315
329, 330, 350, 357, 362, 374, 392, 400.
Holmes, A. L 342, 497 499
Holmes, C. M 487 488
Holmes Jno 402
Hooper, Thos. N 409
Hopkins, Chas. C 97
Hopper, Thos 141
Hornung, Geo 316 322
Horton, W. N 505
Hotchkin, Geo, A 104
Hough, U. B 424
House & Kiersted 447
Howard, J. S 509
Howell, Geo. W 157
Howland, A. H., 42, 48, 56, 57, 58, 260 388
401.
Howland & Ellis 277
Hoxey, Gen. Thos. D. 160
Hugh, J. B. E 552
Hughes, Jno 97
Hull, B. H 82
Humphrey, J 15
Humphrey, J. S 433
Hungerford, W. S 256
Hunt, Chas. W 117
Hurlburt, W. D 421
Hutchinson, W. F 533
Hutton, Wm. R 236
Iler, F. M 503
Inglis & Hunter 559
Inglis, Thos 552
Ingram, Dr. Chas. F. 233
Inman, Geo. B 102, 115, 176, 410, 411 533
Inman, W. F 303
Irish & Quinn 194
Jackson, J. E 361
Jacobus, D. 421
James, David J 536
Jarett, Phaon 191
Jenness, A. R 5
Jervis, Jno. B 18, 130, 541 546
Jobe, S 436 452
Johns & Brewer 12
Johnson, C. W 14
Johnson, J. B 433 436
Johnson, P. D 384
Jones, A. N 429
Jones, D. B 531
Jones, J 440
Jones, J. A 434, 443 489
Jones, J. T 470, 480 488
Jones, R. A 505
Jones, T. M 479
Josel, F. E 375
Joy, Moses 36, 45 250
Judson, C. E 222
Kames, Joshua 179
Keating, E. H 539, 541 542
Keefer, Thos. C 546, 553 556
Keith, G. T 318
Kelly, Jas B 379
Kelley, M. P 483
Kelley, Thomas 530
Kennedy, Jno 557
Kennedy, Wm 555
Ketchum, A. R 266 288
Kiersted, W. 410, 445 453
Kimball, F. C 78
King, James 541
King, J. H 149
Kinley, J. R 393
Kinney, E. C 460
Kinsey & Mahler 372
Kirkwood, Jas. P 37, 43, 57, 89, 94, 131 471
Kluegel, C. H 516
Knapp, Louis H 95, 550 558
Knight, C W., 95, 136, 144, 169, 177, 181 184
221, 230.
Kuhn, W. S 373
Kuich, S. R 430
Kuichling, Emil 104
Laberge, Pierre 548
La France Steam Fire Engine Co 112
Lamson, D. L 5
Landreth & Fitzgerald 134
Lane, Moses 94, 217, 284, 287 398
Lang, W. H 16, 19, 20, 23 111
Langdon, W. F 18
Langford, Jno. T 34 43
Latrobe, Benj. H 203
Lavery, W 557
Leach, H. C 379
Leach, Jas 464
Leavenworth, F. P 251

Engineers.

Ledlie, Chas. H 266, 286, 369	484
Lehman, Benj	190
Lehr & Emery	181
Lehr, S. D	225
Leighley, Chas, J	164
Leisher, E	499
Leland, Geo. H	24
Leonard, Francis	131
Lewis, Saml	196
Libby, B. C	492
Lilly, E	423
Little, Horace	220
Locke, Frank B	52
Lockett & Fuller	287
Lockett, S. H., 278, 300, 329, 338, 340 387, 433, 437, 440, 449, 464.	366
Lockwood, Jno 107, 110, 116	130
Lor, Henry	549
Low, G. P	326
Low, J. M	135
Lowe, Moses	52
Loweth & Curtis 393	418
Loweth, Chas F 393, 406, 418	420
Lowry, Jos L	301
Lund, Chas	18
Lund, C. E	45
Lynch, M. L 478, 479	488
Lythe, F. E	169
Mc Alpine, Wm. J....37, 51, 89, 95, 116 516.	127
McCane, D. J	497
McClare, Jas. O	142
McClean, Chas. B	243
McClelland, D	259
McClure, J. O	134
McConnell, Walter F.	43
McCormick, A. H 469	476
McCormick, A. W	441
McCormick, Jno	249
McCullough, Jas., Jr	231
McDonnell, H. W	310
McDonald, John	544
McDowell, Jno	328
McElroy, Saml	94
McFarlane, P	560
McGinley, Ed.	221
McGinley, E. P	232
McKenzie, T. H. 80	84
McLain, C. F. 450	453
McLennan, C.	382
McLoughlin, H.	482
McMullin, J	188
McRae, S. P	183
McReynolds, Mr. L	302
MacRitchie & Nichol. 342	400
McRitchie, Chas.	475
McWilliams, H. H	505
McWilliams, J. B	505
Maguire, Capt. Edw	422
Mahlo, Emil	298
Mahoney, J. F	533
Manning, Robt. K	252
Manthey, W	290
Marsh, Geo.	79
Marsh, Jno. J	34
Marshall, G. A	394
Martin, J. H.	394
Martin, J. M	510
Martin, Jno. E	544
Martin, Jno. P.	326
Martin, R. K 184, 237, 239	241
Martin, T. F.	501
Martineau, Jas. H	536
Maslin, J. H	242
Mason, H	372
Mason, M.	61
Mason, W. A	26
Mason, W. P.	504
Masson, F. S.	200
Masten, C. S.	469
Masten, W. C.	469
Mather, Mason W.	496
Mathers, M. W	491
Mathews, J. E.	231
May, L. D	445
Meigs, M. C.	243
Merchant, Ira.	367
Merrill, G. G	57
Metesser, Louis. 282	487
Meyers & Son	356
Meyers, Geo. F	487
Meyers, Lewis	506
Michigan Pipe Co., 337, 349, 351, 360, 364, 394.	361,
Miller, A. C	422
Miller, A. N	270
Miller, Donnell	460
Miller, D. B	265
Millet, R. D	455
Milne, Alex	550
Milner, W. S	277
Mines, W. W	151
Mitchell, G. A.	420
Moak, Saml.	103
Moffett, Modgkins & Clarke, 89, 93 104, 107, 108, 116, 142, 145, 262, 311, 392 398, 550, 551	100 393
Molden, D. N.	530
Monro, Thos. 554	558
Monroe, H. E	361
Monroe, Albert J	454
Moore, A. C	31
Moore, A. G 301, 305	309
Moore, Jno. M.	560
Moore, M. M 261, 330, 393	394
Moore, R. 168	217
Moorehead, T. S	438
Morey, P. F.	509
Morgan, Edgar	528
Morgan, Geo. C., 310, 335, 333, 353, 359 368, 372, 377, 379, 381, 383, 384, 385, 386 389, 390, 402, 414, 427, 448.	367 388
Morgan, S. H	115
Morison & Corthell	454
Morris, Wm. E 173	199
Morrison, Ellis, 178, 223, 235, 311, 315	331
Morrison, L	255
Morton, B. R	298
Mullins, R. F	102
Munger, L. C	504
Murdoch, Gilbert	539
Murdock, Geo.	44
Murphy, Howard 156	255
Murty, W. S. Jr.	514
Nash, G. D	24
Neilson, Robt	172
Nelson, W. H	437
Nesbit, J. J	437
Newman, Emil	521
Newman, Geo H	27
Newman, G. O	522
Nier, J. W. 372, 432, 435, 433, 434, 436 452.	442
Noble, Jno. T	363
Norman, Geo. H 36, 52, 70	72
Noyes, Alfred F.	52
Oberg, Gus	421
O'Connor, Chas.	396
Odell, Frederick S	155
Peck, E. H	431
Ogden, Jno. L.	202
O'Neil, Jas. A.	429
Orton, C.	428
Orton, M. C. 478	482
Osborne, Jno	86
Osmer, Walter A	334
Ostrander, O. H	178
Ottman, Louis	114
Owen, Jas.	157
Paine, C. W	451
Palmer, Ed	459
Parish, H. G.	382
Parker, W. S. 97, 113, 143	364
Parrot, E. D.	507
Parsons, Wm. Barclay	476
Patrick, Jno	558

Engineers.

Patterson, T. L. 241
Pearsons, Galen W., 126, 130, 288, 430 437
439, 461, 500.
Pearson, H. C. 106
Peek, E. H. 431
Pecke, F. S., ...100, 107, 116, 425 551
Peebles, A. O 320
Pennington, B. C 419
Pentland, Robt. 510
Perin, C. M 495
Perkins, P. B., 335, 417, 440, 462, 464 465
466, 468, 473, 477.
Perkins, N. W 436
Perry, Wm. 553
Peters, [illegible]urd 539
Poterson, B. W 260
Petry, A. 292 294
Pettee, Wm. E. 56, 96 77
Peyton, Geo. 256
Pfifenberger, Lucas 390
Phelps, ——, ... 341
Phelps, Geo. W. 345
Philbrick, Edw. S. 31
Phillips, R. C 321
Phillips, Wm 267
Phinney, H. W. B. 162
Phipps, Geff. D 83 87
Pierce, C. H. 41 65
Pierson, Geo. H 164 196
Pike & Sturtevant 425
Pike, D. W 439
Pike, R. D. 393
Pilsbury, —— 410
Pillsbury, J. L. 302
Pogue, A. L. 475
Pollard, W. D. 219
Porch, Jas. 368
Potter, J. W 421
Potts, Chas 164
Powell & Middleton. 234
Power, Jas. J 274
Preeze, P. W 399
Price, Geo. E 395
Prince, Edw. 385
Pritchard, P. M. 446
Provines, W. G. 460
Purdy, J. H. 373 397
Quigley, J. B. 465 473
Raeder, F. W., 43, 434, 436, 368, 382, 470 476
Rafter, Geo. W 104
Ramsey, J. W 170
Ransom, Danl. 498
Rand, J. B. G. 109
Rand, J. B. S 131
Randall, J. B 21 24
Randall, S. C 106
Ray, H. A 504
Raymond, Geo. 38
Raymond, Maj 712
Raymond & Campbell 186
Read, A. J. 136
Reed, F. H. 529
Reeves, Jno 470
Rhodes, Ben J. 125
Rhodes, D. H. 434
Rice, H. 170
Rice, L. F 43
Rickon, F. J 477
Richards, W. H 82
Richardson, A. A., 407, 413, 437, 439 446
447, 448, 449, 451, 452, 453.
Richardson, L. J 100
Richardson, Jas. A 500
Richardson, W. D 485
Rider, W. B., 76, 79, 80, 85, 101, 107, 109 114
127, 130, 134, 137, 141, 143, 160.
Rigley, H. E 176
Rinker, Andrew. 424
Roberts, W. N 98
Robichon, P. N 549
Robinson, A. A 497 503
Robinson & Tracy 554
Robinson, W. M 393
Root, L. F 65
Ross, Thos 20
Rossi, J. C 99
Rosewater, Andrew 447
Roth, F. A 182
Rotch, Wm 37
Rowe, S. M 503
Rowley, H. W 461
Rudiger, E. A 449
Russell & Alexander 482, 500 503
Russell, W. S 456
Rutherford, Jno. W 79 470
Rutter, J. C 190 226
Sales, W. A 509
Salino, —— 491
Sanford, D. C 86
Sanford, W. C 442
Sargent, A. F 47
Savier, S. D 426
Sawyer, Edw 52 63
Sawyer, E. B 499
Sawyer, Solon 349
Schaeffer, Jno 173
Schwaler, Jno. G 173
Schaff, Frederic 52
Schaituer, Jacob 224
Schefold, F. 336
Schlesinger, A. D. 99
Schreuneller, Jacob 170
Schroeder, Chas 9, 451, 452 449
Schussler, Hermann 526, 527, 530 536
Schuyler, Jas. D 518
Scofield, H. G 85
Scott, Edward 350
Scott, Jno 186
Scowden, Theo. R 296, 306, 308, 320 334
Sears, Walter H 5, 27, 97, 73 427
Sekoll, A. C 337 359
Serry, L. L 48
Seversedge, A 260
Seymour, C. W. S 40
Seymour, J. A 173
Shalen, Augusta 506
Shackelford, R. M 518 529
Shedd & Sawyer 41 65
Shefold, Frank 372
Shelley, C. F 137
Shepherd, O. D 222
Shepherd, O. L 169
Shedd, J. Herbert 1, 74 75
Shedd & Sawyer 48
Sherman, W. B 498
Sherwin, I. W. F 183
Shryock, S 532
Sickler, Harvey 229
Sickles, F. E 468
Simmons, J 429 468
Simmons, J. S 437 496
Sink, W. D 512
Slade, Jas 57 237
Slaney, Jno. M 463
Slaw, B. F 432
Slaymaker, S. M 189
Slemons, Jas 349
Slockett, Lewis 391
Smalley, E. D 92, 95, 96 132
Smedley, E 283, 412 494
Smith, A. T 175
Smith, Chas. A 25, 465 470
Smith, C. E 97
Smith, Erastus W 284
Smith, F. E 38
Smith, Geo. P 139 346
Smith, Isaac W 506
Smith, Jno. R 60
Smith, W. A 88
Smith, Willard 159
Snow, E. J 300
Snow, W. W. 107
Snyder & Williams 339
Soper, E. S 260
Stair, W. H 433
Stanley, O. G 62 70

Engineers.

Starr, Saml. C. 313
Stauffer, D. McN. 444
Staunton, E. M. 97
Stein, Albert 249, 254, 284, 290
Stephens, B. F. 102, 319
Stevens, F. F. 441
Stevens, G. C. 332, 340, 480
Stevens, Jos. 416
Stevens, J. S. 429
Stevenson, C. L. 28
Stevenson, J. B. 179
Stickney, Dean 301
Stilson, W. B. 82
Storrs, Dan 436
Strang Co., A. L. 445, 448, 450
Stripe, W. C 412, 418
Sturtevant, Geo. W. 446
Surtees, Robt. E. 545, 558
Sutherland, Geo. 446
Sutherland, W. E. 534
Sutphin, F. 485
Sutton, Wm. T. 240
Swan, Chas. H 57
Swift, McRee 80
Tabor, Capt. 144
Talbot, T. J. 438
Taylor, C. F. 378
Taylor, C. T. 550
Taylor, Harry 365
Taylor, L. A. 61
Taylor, W. W. 239, 241, 243, 261, 285
Terrell & Muckle 274
Thomas Bros. 521
Thomas, C. B. 176
Thomas, F. H. 224
Thomas, J. D. 487
Thomas, R. B 219
Thomas & Gorman 478
Thompson, D. P. 507
Thompson, R. R. 511
Thurston, S. D. 515
Tidd, M. M., 4, 6, 7, 18, 34, 35, 40, 42, 45, 48, 51, 55, 66, 544.
Titcomb, J. S 492
Tracy, —, 550
Tracy, E. H. 120
Trask, F. E. 519, 520
Troy, W. 458
Trump, E. D. 187
Tubbs, Nelson J. 104, 115, 132
Turner, Fremont 416
Turner, Robt. 559
Tuttle, E. A. 522
Tyson, A. Harvey 193
U. S. Wind Engine & Pump Co., 369, 406, 443.
Van Buren, Robert 94, 95
Van Doren, J. L. 129
Van Harlingen, M 198
Vanier, T. E. 549
Van Liew, E. S 365
Van Volkenburg, J. J 24
Versey, E. 200
Von Schmidt, H. W. 535
Voorhis, Wm 126
Wagner, E. C. 184
Wagner, L. J 269
Walker, J. M. 329, 387, 437, 461
Walker, J. S. 277
Walker, M., 341, 342, 346, 350, 354, 356, 358, 359, 360, 363.
Walker, T S. 483
Walkenburg, J. J 56
Ware, A. 557
Ward, Jno F. 153
Waring, W. S. 503
Warner, F. W. 127
Waron, Major 436
Wasell, E. 542
Waters, Jas 423
Watson, W. S. 170
Watts, Sylvester 482
Weaver, G. Norman 38, 72, 108, 136
Webber, Wm. B. 32
Weed, O. W 551
Weir, E. G. 149
Weir, J. C 405
Weir, Wm. C. 292, 310, 407, 413, 415
Welsh, Henry 372
Welsh, —, 220
Welton, Nelson, J 53, 87
West, Jno. 415
Weston, E. W. 222
Weston, Jos. A 13
Weston, Theo. 102
Westcott, Nelson 534
Wetherill, Price 229
Wheeler & Parks 3, 14, 33, 83, 85, 273
Wheeler, E. P. 375
Wheeler, Wm 30, 36, 63
Wheelock, Chas. G. 550
Whilby, Wm 202
White, C. A. 280
White, C. W. 490
White, G. W 132
White, T. R. 268
White, Wm. H. 280
Whitelaw, J. 306, 308
Whitling, Danl. 221
Whitney, Geo. E 85
Whitman, Thos. J., 288, 295, 369, 428, 466, 484, 503.
Whitner, J. F. 359
Whittemore, A. Jr. 18
Whittemore, Walter P 53
Whitwell, Wm. S. 20, 28, 55, 153
Wickham, C. H. 228
Wightman, Henry M. 68
Wiley, S. L. 39, 40, 128, 323, 417
Williams, Benezette 385, 402
Williams, E. H. 523
Williams, Jas. 180
Williams, Frank J. 396, 462
Williams, Robt. E. 425
Wilson, C. H. 551
Wilson, H. B. 424
Wilson, Robt. H. 196, 231
Wilson, Wm. M. 146
Winchester, G. C. 26
Witmar, T. F 373
Wolcott, E. 377
Wolcott, Geo. D. 343
Wolfe, Jas. B. 538
Wood, W. H. 456
Woolston, Geo. F. 462, 504
Worthen, Wm. E. 79, 99, 113, 253
Worthington, Henry R 270
Wright, E. T. 513
Young, A. 532
Young, J. Marshall 161, 226
Young, Jno. 104
Young, Jno. P. 16
Yocum, Jacob H. 268

CONTRACTORS.

[Includes Sub-Contractors, also.]

Aldeman, Frank 179
Aldrich & Hill 63
Allen, C. D. 66
Am. Const. Co. 222, 232
American Gas & Water Pipe Co. 105
American Water & Gas Works Constr. Co. 406
Andrews, C. E. & Son. 197
Arbuckle, F. P. 498
Armstrong, Geo. 391

Contractors.

Awalt, C. 243
Bacon, Wm 367
Baldwin, Ely 233
Bardell, C. T 388
Barthold, L. & Co 193
Bartholomew, Seymour L. 156
Barton, J. F 458
Bartowe, G. W 136
Bassett Bros 91, 93, 98 106
Bates, J. Walker & Co 285 475
Baum, J. W 267 269
Beach, G. E. 409
Beattie, Geo. 326
Beauchemin & Sons 545
Beckwith & Quackenbush 107
Beer, Isaiah 553
Béique, J. B. A 543 531
Bement, R. B. C 402
Bentley Randolph & Co. 75
Berger & Béique 548
Blackmore, J. J. & Co 557
Blake, Geo. F. Mfg. Co. 22
Blakeslee, Chas. W. & Son 83
Boren, Jno. W 317
Bradley, J. W 379
Bridges, E. L. 486
Briggs, Abram T. 53
Brown, A. K 416
Brown, W 480
Brown & Connor 484
Brown & Doyle 92
Brundige, Wm. H 278
Buehner, Philip 505
Buell, Ward S. 91
Bullock, Saml R., 176, 178, 223, 273, 283 281
298, 305, 311, 315, 316, 331, 332, 339, 402 481
Bunker, Theo. 395
Burbridge, B. 364
Burbridge & Watkins 364
Burns, Jos. 479
Burton & Snell 103
Bynner, Edgarton 114
Campbell, E. C 354
Capener, Geo. C. 392
Carpenter, S. D. & Co 414
Carnie, J. & Son 567
Carrie, J. & Co. 560
Casey, C. D 270
Cassidy & Murray 312
Cassin, I. S. & Co 23 179
Chabot, M 526
Chambers & Casey 104 132
Champlin, Henry 75
Chapman, W. S 508
Chappell, D. A 76 501
Cheeseman & Co 390
Clarke, Ben S 439, 446, 447, 448 453
Clarkson, D. A 161
Clifton, Jno. & Co 336
Cloud, J. A 300 262
Coats, W. R 527
Coatsworth, —, 558
Cochran, S. R 184
Cody, Jas 522
Colo. Machinery Co 492
Comegys & Lewis., 300, 329, 338, 340 367
357, 433, 437, 444, 449, 464.
Compton, S 324
Conger, David 336
Conn. Patent Water Pipe Co 18, 83 87
Connor, P. E 529
Connor, W. C 478
Coit, G. 512
Cook & Horton 436
Cook, E. H. & Co 225
Cook, G. & Son 15
Coon, A. H. & Co 166, 218 231
Coon & Mooney 104
Cope & Maxwell 334
Copp, Wm. 559
Cookish, Jno 505
Cosgrove, Jno 299
Cossette, Octave 549
Coverdale & Weir 313
Cowell, Truman 406 412
Cowell, T. E. 417
Crane Bros 513
Crocker, J. W 9
Crook, Horner & Co 242
Crowell, Geo. S 20
Curlin & Palmer 169
Dana, Geo 560
Daniels, Geo. W 445
Daniels, Travers 414 476
Davin, —, 249
Davis & Kelly 146
Davis, J. 511
Davis, Saml. W 303
Dean Bros 334
Delameter, D. D. & A. H. D 306
Delfar, F. L 419
Denison & Cowell 418 419
Denithorne Bros 172
Denithorne, Richard 216
Dezeng, W. D 104
Dickinson, H. L 378
Dodge, Hascal 34
Doerzbach & Duker 319
Donovan & Holland 365
Dougherty & Ferguson 317
Drake & Orton 430 482
Drulard & Hayes 112
Durfey, F. B. 74
Dwyer, Jno 433
Dyer, Eph 4
East Texas Water & Gas Co. 483
Eastern Constr Co 388
Eclipse Wind Engine Co., 375, 376, 394 497
Ellis, Jacob 328
Ellis, N. W. & Co 13, 15 16
Esbach, Jno. E 152
Fairbanks, Morse & Co, 333, 367, 381 384
393, 411, 418, 432, 446, 459, 476.
Farrar, Wm 162
Farrell, T. E 448
Fasnacht, C. 338
Faunce, Elijah 24
Faunce, G. A 24
Felton, S. K 447, 451, 452 458
Ferguson, Mitchell & Co 558
Ferris & Halladay 3, 6, 14, 36 155
Fish, A. L. 512
Fish, D. B. 302
Fisher, —, 322
Fisher, D 384
Flagler & Babcock 105
Flint, Walling & Co. 362
Foegey & Co. 231
Foerder, Chas. & Co 378
Foncher, T U 543
Foote, Jno. 544
Ford, Jno 443
Foster, H. L. 232
Fox & Wilde 531
Frazer, Wm. H 544
Freel, Ed 138
Freeman, W. R 487
Froer, Henry 231
Frost, M. S. & Son 300
Fruin & Co 427
Fuming, H 403
Gane, Jos 259
Gannon, Thos 189
Gardiner, J. J. & Son 533
Gardner, Geo. I. 149
Gas & WaterWorks Constr. Co 190
George, E. & Co 344
Gerich, G. 486
Gibson, B 556
Gillen, C. E. 322
Girton, G. B. 198
Glamorgan Co 249 251
Goodhue & Birnie, 12, 15, 16, 18, 19 20 23
26, 36, 40, 42, 44, 45, 51, 53, 54, 58 59, 66 85
86, 97, 326, 342, 388.
Gorman & Rennie 479

Contractors.

Granger, A. O	548
Graves, J. S	195
Gray Bros 403, 457	458
Gray, C. E. Jr 422, 465, 470, 475, 486	497
Groscup & Keith	478
Grove, Geo. H.	186
Grubbins, Jno	331
Hague, Thomas	529
Hallivan Bros	112
Hammond, W. H	531
Hanes, J. H	150
Harlow, Jas. H 96, 194	227
Harper & Reynolds, Co. 516	517
Hein, Jno. Jr	558
Hendrickson, J. D.	312
Hennessey, Thos 58	456
Hickler, Jno	95
Hill, D. C	336
Hill, Ellingwood & Frances	27
Hinds, F. E	394
Hoar, J. A	71
Holly Mfg Co., 92, 101, 111, 166, 240, 314 316, 319, 324, 329, 330, 333, 349, 350, 357 374, 364, 387, 394, 400, 403, 406, 446, 455.	315 358
Holmes, A. L. 193, 360, 497	499
Holmes & Wickes.	499
Holmes, C M	487
Howland & Ellis	277
Horton, Calvin & Son	35
Hopper, Thos	141
Houghton, C. M.	377
House, H. K	317
Howard, L. T.	366
Howland, A. H	358
Hubbard, R. D. & Co	423
Hubbard, Wm. E	75
Hubble, O. W	317
Hult, Jno	419
Hull, Theophilevia	545
Hunkey, J. M	372
Inglis & Hunter	559
Inman Bros 102, 109, 115, 410	411
Inman, Geo. B 50, 176	533
Interstate Gas & W. Wks. C	465
Iowa Iron Works	375
Irish & Quinn.	194
Jaeger, Guido	431
Jamison, J	294
Jenkins, David.	537
Jenks, J. & Co	363
Jeter & Boardman, 268, 271, 272, 274	281
Johnson, Martin.	448
Jones, J	440
Jones, J. A	468
Jones, J. T	480
Jones & Tiernan	429
Jones & Thorn	239
Jordan & Soumate.	255
Joslyn, Jno	373
Kelly, A. & Co.	326
Kelley, M. P	487
Kelley, T. P.	328
Keogh & Shaw	63
Kershner, Jno.	322
Kirkbride, S. W	148
Knox Bros	515
Koenig, A	515
Koenig, F	515
Kraus, Henry.	314
Kurcher, P	395
La Chapelle, Jos.	559
Lamb & Raymond	384
Laney & Churchill.	385
Langlood, J. T 43	61
Lapig & Co	484
Lapoint, Jno	62
Lant, Geo	330
Leach & Baldwin	73
Leare, Geo	243
Leeming, Thos.	152
LeMoyne, Geo	273
Lenahan, Chas	67
Leonard, C. T. & Son 80	86
Leonard, Francis 84, 108	145
Leopold, H. A 195, 196	402
Lester, Gurley	345
Lewis, Henry	104
Libbey, G. E. & Son.	397
Ling, Wm. C	139
Livezy, H.	179
Lobdell & Cornish	37
Lockwood, Jno 107, 116	130
Loeffler & Co	379
Logan, J. M	381
Long & Doubleday	481
Low, J. M 103, 111, 128	135
McAdams & Co	337
McArdle, P. F.	255
McArthur Bros	426
McBride & Hennessey	31
McClallan, W. C. 34, 35, 48, 57, 58	66
McConnell & Hickler	247
McCormick, A. H 435	469
McCormick, R. P	435
McCormick & Moran 310	324
McCoy, W. W	534
McDonald, Jas	132
McDonald, J. K	544
McDonnel, A. A.	307
McDonnel, Jos. A	307
McGuire, H. D	508
McIntosh, J. W	544
McIntyre, Albert	322
McMahon, J	173
McMahon, M	173
McMahon & Keefe	255
McNamee & Co	157
McNamee, Jno	253
Mahony, M	195
McQuillan & Co	555
McRae & Lally 432	481
MacRitchie & Nichol	342
Mangan, Jno	37
Manning, A W.	406
Marr, W. T	255
Martin, Jno	544
Martin, T. F.	501
Mason, C. A. & Co	296
Mayock & Burns	454
Megoun, A. C.	198
Menefee & Parkins.	255
Mercer, T. M	379
Metcalf, A. D	448
Michaels, R. H	318
Michigan Pipe Co 302, 337, 361	499
Millen & Burket	196
Miller, Adam & Co. 75, 95	144
Miller, Conrad	149
Miller, Geo. H.	545
Miller, Jno	403
Miller, M. J	521
Mills, Peter.	400
Mills & Storey	278
Minahan, D. F	315
Mitchell, D. & Co,	436
Moffett, Hodgkins & Clarke, 89, 93 104, 107, 108, 116, 127, 142, 145, 262, 311 378, 392, 393, 397, 398, 425, 550, 551.	100 350
Morgan, G. C., 336, 353, 368, 372, 377 390, 402, 427.	384
Morrison, W. W	187
Mosser, J. G	344
Mullins, R. F	102
Munch & Locke.	427
Murdock & Colvin	260
Murphy, Dennis	146
Mutchler, S. B	161
National Bldg. Assoc.	560
National Iron & Brass Wks.. 412, 420	424
National W. Wks. Constr. Co.	261
Neahr, Jas. H	103
Nelson, N. O. Mfg. Co	429
New England Constr. Co	136
New Lisbon Stone Co	318

Contractors.

Newman, Jas. J 4, 5, 10 72
Nevins & Reimer 373
Nichols, Davis M 146
Nichols, J. W. & Co 278
Niemes & Reiman 390
Nixon, James 230
Noble Bros. & Co 270 276
Norcross Bros 155
Norman, Geo. H., 26, 36, 47, 48, 49, 51 52
54, 70, 108.
Northey, J. P 555
Northwestern Water & Gas Supply Co 457
Norton, P. M 372
O'Brien, Jno 435 509
O'Donnell, Jno. P 466
Ohren & Schwartz 230
Ontario Pump Co 559
Orton, Drake & Bonebrake 442
Palmer, E. E. & Son 430, 433, 437 438
Parker, W. S. & Co 361
Parry, J. J 133
Patent Water & Gas Pipe Co 58 67
Patrick, Wm 129
Patterson, L. F 268
Pearsons, G. W 433
Pennsylvania Pipe Mfg. Co 184
Perkins, P B 376, 417, 465 477
Peterson, B. W 259
Pfleffer, Jno. & Co 268
Phelps, Geo. W 343
Philbin, M. & Co 324
Pierson, Iona 440
Pike, H. & Son 55
Pittsburgh Water & Gas Constr Co 317
Pond & Musten 469
Porch, Jas 368
Porter, Jno 195
Porter, N. C 61
Porter Mfg. Co 322
Powett, C. H 456
Price & Stamberg 337
Price Mfg. Co 393
Pyle, ——, 186
Quinn, Jno 552
Raymond & Campbell 186
Ravell & Pipple 335
Real & McTate 216
Reed, H. J. & Son 97
Regan, Thos. H 198
Rich, Jas. W 495
Richards, Hugh 355
Richards, Ralph 449
Richardson, Wm 162
Richardson, W. D 485
Rider, Genung 136
Ringer & Kunner 225
Riter & Conley 392
Roberts, Edw 240
Roberts, Wm 560
Robertson, E. H 322
Robinson, J. I 268
Rockford Const. Co 381
Rook, J. R 27
Ross, R. H 372
Rondeau, E. A 543
Rumsey, J 316
Rush, M 258
Russell, Chas 326
Russell & Alexander, 432, 442, 495, 496 498
500, 503.
Russell & Bawker 300
Russell & Craig 340
Russell & Washburne 300
Rutherford, Jno. W 75 153
Ryan & Booth 556
Ryan & McDonald 113
Ryan & Spellacy 322
Sanber, Martin 379
Saul, Wm 555
Saunders & Church 504
Scharler, J. G 173
Scheid & Jarrett 220
Schleekman, Jacob 314
Schroeder, C 447, 449 452
Scovel & Irwin 276, 281 295
Seagler, A 198
Shailer, —— 315
Shanks, W. F 294
Shanley, Edw 97 143
Shepherd & Cox 440
Shelton, Nathan 374
Sherman, E 552
Sherman, Wm 79 112
Sherman & Flagler 132
Sherman & McDonough, 95, 96, 112 116
134.
Sherrill, Wm 559
Shickle, Harrison & Howard Iron Co 368
Shield, Lambert & Co 191
Shingles, Levi 233
Shrunn, Moses 337
Sillman, W. L 517
Simar, V. D. & Co 425
Slemons, J 349
Smedley & Wood 283
Smith, H. R. & Co 334
Smith & Vaile Co 317
Snow, F. A 75 80
Snyder & Williams 328
South Pueblo Mach. Co 495
Spore, J. L 508
Stacey, Geo. & Co 305
Stainthorpe & Houston 113
Stanley, L. B 392
Stanton & Doyle 98
Stein, A 284
Stevens & Burns 554
Stephens, B. F 102 319
Stephens, Turner & Burns 550
Stevens, A. W 332 397
Stevens, L. B 296 483
Stevenson, J. J 517
Strang, A. L. Co 445, 448, 450 453
460.
Studley, E. G. & Co 362
Sullivan & Conroy 248
Sullivan & Wilkerson 132
Sutherland & Corcoran 541
Sutherland, Wm 542
Sutphin, E 434, 439, 442 485
Sylvester, Lewis 366
Taylor, E. E 487
Taylor, W. W 285
Thacher & Breymann 401
Thomas & Gorman 478
Thomas & Storrie 479
Thomas Bros 62
Thomas, R. B 219 220
Tibbs, T. L 99
Tilton, Edw 156
Tippett & Wood 396
Tippett, Chas. E 240
Tourville & Co 55
Turnbull & Thomson 557
Turner, Clarke & Rawson 7 438
Turner, Fremont 416
Tierney, Myles 153
Tyson, A. Harvey 193
Union Iron Works 269, 270 285
U. S. Wind Engine & Pump Co., 369 382
406, 410, 411, 412, 416, 418, 443, 444, 457.
Urban, Amos 189
Van Doren, J. L 129
Vanhorne, C 27
Van Vranken, Benj 130
Vergennes Machine Co 24
Wagner, Aug 373
Wagner, Jacob 139
Wakefield, E. W 417
Walker, M 350, 356 358
Walters, W. A 127
Ward, Jno. F 153 259
Warren, Gardner 33
2

Contractors.

Water, Light & Power Co 436
Watts, Seymour 482
Weaver G. Norman 71
Weeks, C. A 446
Wellen, A. K 419
Welsh, Jas 559
West, Jos. A 537
Wheeler & Parks 3, 14, 30, 85 273
White, G. W 132 143
White, J. C 508
White, Wm 523
Whitling, Daniel 221
Whitsitt & Adams 290
Wilby, Reuben 392
Wiley, S. L 40 360
Wiley Constr. Co., 323, 337, 396, 401, 417 451
Willard, Cyrus 531
Williams, Robt 99
Williamson, G. S 108
Wilson, E. 364
Wingate, E. B 331
Wisconsin Const. Co 320
Wood, R. D. & Co., 20, 24, 97, 109, 134 148
156, 181, 192, 229, 230, 250, 303, 479.
Woolston, Geo F 462 504
Woodbury, R. A 48
Woodford, Geo 285
Woodruff, Jno 113
Wright, I. G. 78
Yeemer, H. T 547
Yenter, Z 187
Young, Marshall, J 226
Zimmermann, Saml 556

NOTICE.

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A Classified Index

to advertisements will be found at the front of the book.

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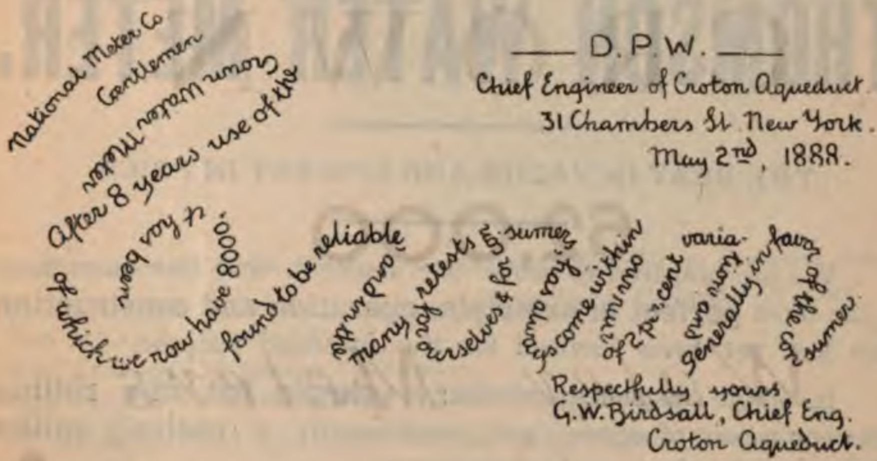

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Hoboken, N. J	2447	Atlantic City, N. J	329
Pawtucket, R. I	2153	Montreal, Can	324
Rochester, N. Y	1768	Brookline, Mass	279
Newton, Mass	1752	New Rochelle, N. Y	258
Boston, Mass	1655	Chicago, Ill	252
Yonkers, N. Y	1427	Orange, N. J	238
Brooklyn, N. Y	1369	Elmira, N. Y	231
Atlanta, Ga	1180	Fitchburg, Mass	230
Kansas City, Mo	1084	St. Paul, Minn	228
Lawrence, Mass	894	Princeton, N. J	217
Des Moines, Ia	785	Morristown, N. J	209
St. Louis, Mo	574	Louisville, Ky	188
Montgomery, Ala	551	St. Joseph, Mo	173
Alameda, Cal	550	Flushing, N. Y	173
Phila, Pa	540	Minneapolis, Minn	154
Utica, N. Y	537	East Saginaw, Mich	134
Toronto, Can	520	Westerly, R. I	134
Poughkeepsie, N. Y	493	Bay City, Mich	133
Manchester, N. H	488	Lake Village, N. H	133
Toledo, Ohio	463	Memphis, Tenn	115
Syracuse, N. Y	430	Attleborough, Mass	112
Lowell, Mass	383	Fort Wayne, Ind	108
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Hon. Theodore W. Myers, *Comptroller,*
Hon. George W. Birdsall, *Chief Engineer Croton Aqueduct.*

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Commissioner of Public Works.

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CHAPTER I.—Introductory. CHAP. II.—Quantity of Water Required. CHAP. III.—Rainfall. CHAP. IV.—Flow of Streams. CHAP. V.—Storage and Evaporation of Water. CHAP. VI.—Supplying Capacity of Watersheds. CHAP. VII.—Springs and Wells. CHAP. VIII.—Impurities of Water. CHAP. IX.—Well, Spring, Lake, and River Supplies.

SECTION II.—Flow of Water through Sluices, Pipes and Channels

CHAPTER X.—Weight, Pressure, and Motion of Water. CHAP. XI.—Flow of Water through Orifices. XII.—Flow of Water through Short Tubes. XIII.—Flow of water through Pipes under Pressure. CHAP. XIV.—Measures of Weirs and Weir Gauging. CHAP. XV.—Flow of Water in Open Channels.

SECTION III.—Practical Construction of Water-Works.

CHAPTER XVI.—Reservoir Embankments and Chambers. CHAP. XVII.—Open Canals. CHAP. XVIII.—Waste Weirs. CHAP. XIX.—Partitions and Retaining Walls. CHAP. XX.—Masonry Conduits. CHAP. XXI.—Mains and Distribution Pipes. CHAP. XXII.—Distribution Systems, and Appendages. CHAP. XXIII.—Clarification of Water. CHAP. XXIV.—Pumping of Water. CHAP. XXV.—Tank Stand Pipes. CHAP. XXVI.—Systems of Water Supply.

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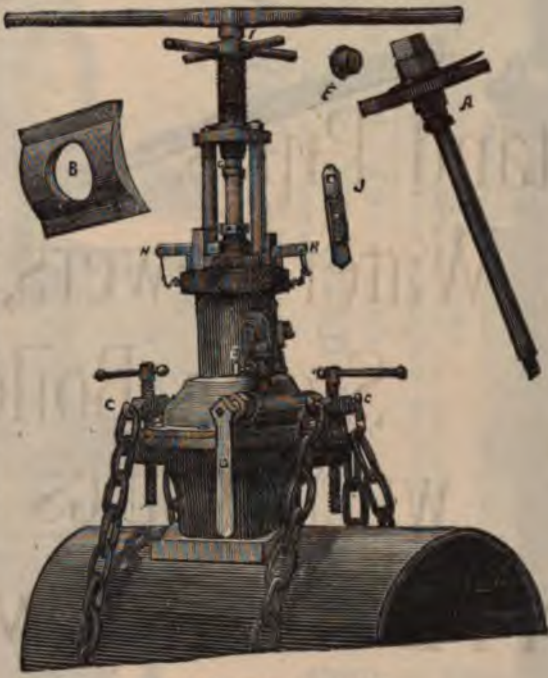

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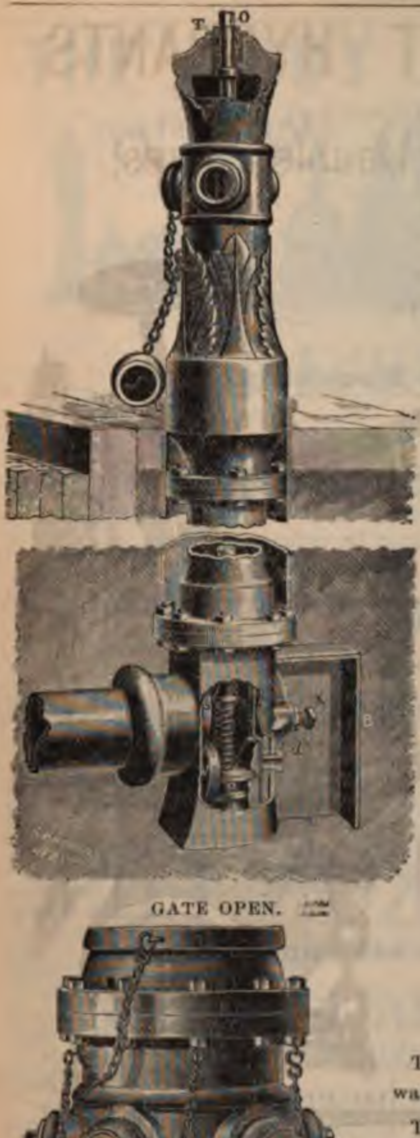

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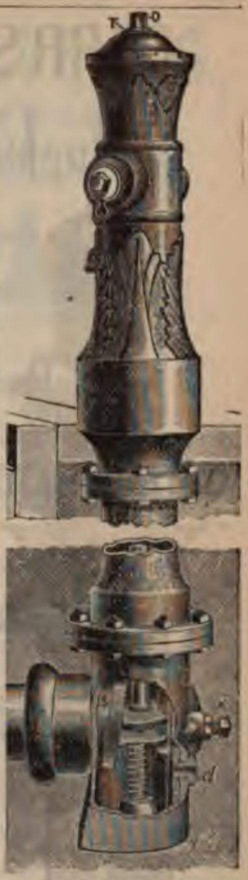

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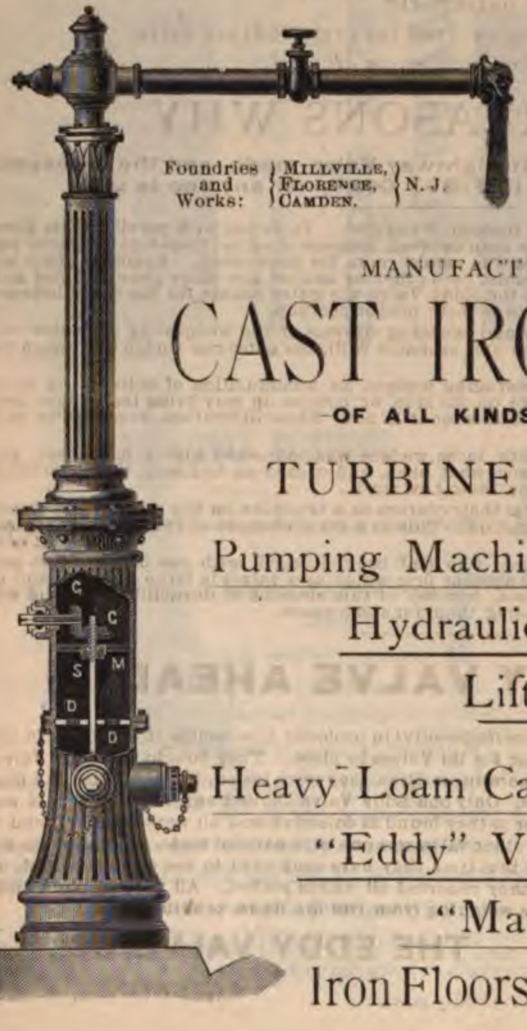

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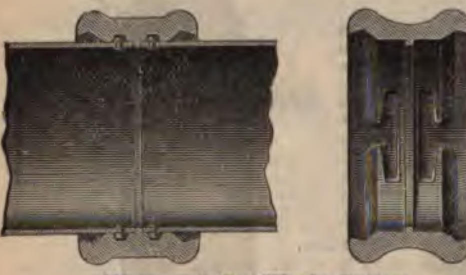

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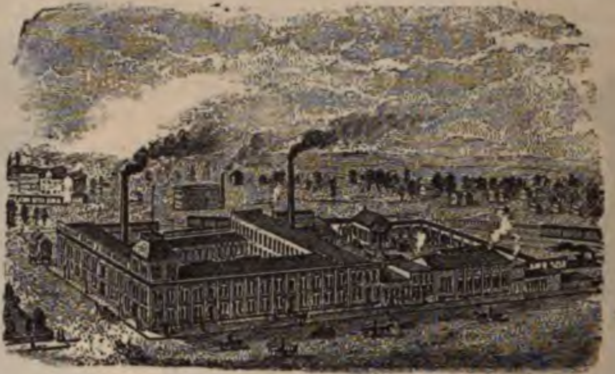

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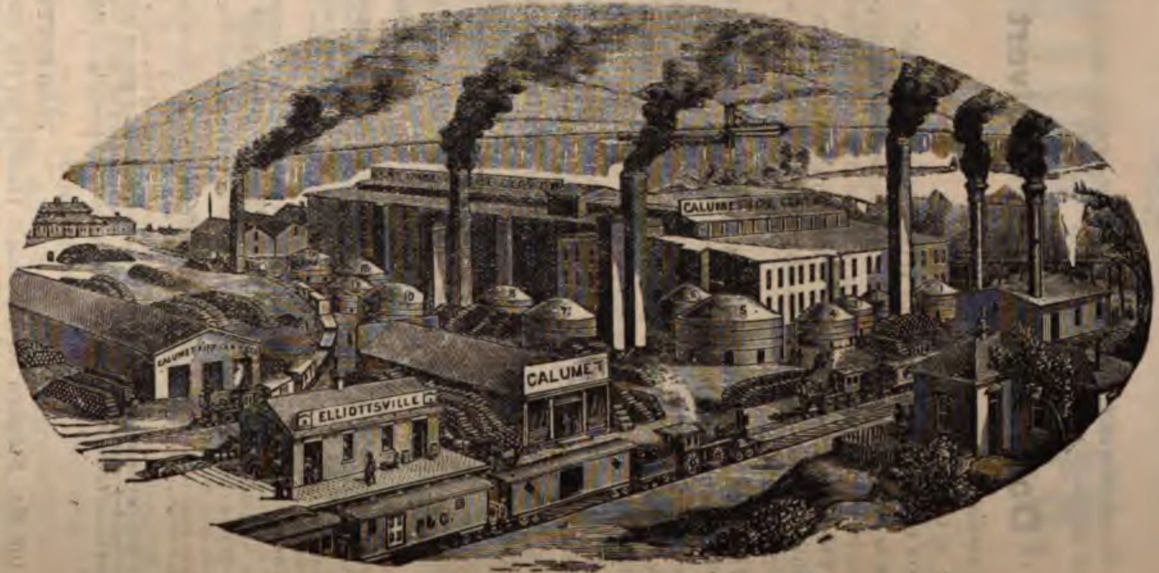

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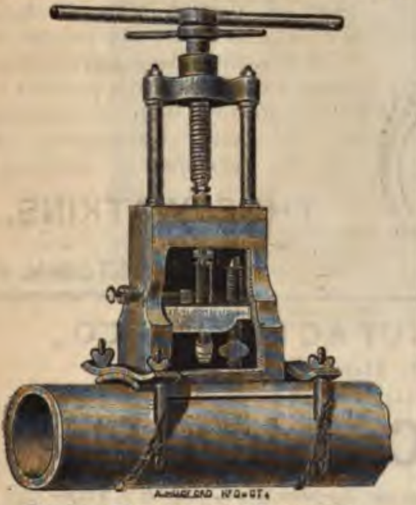

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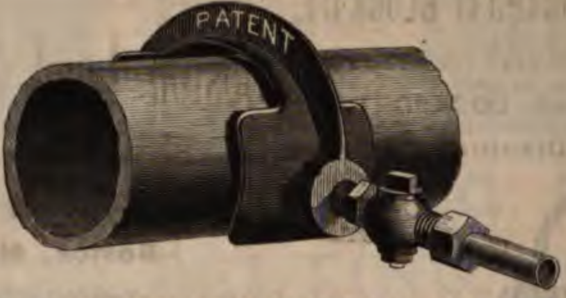

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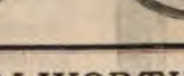
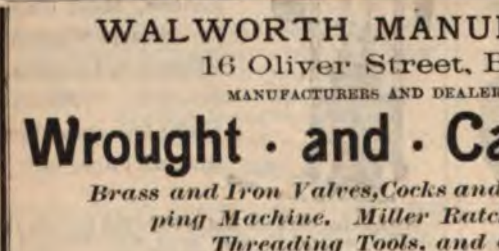
Watkins'  *Patent.*



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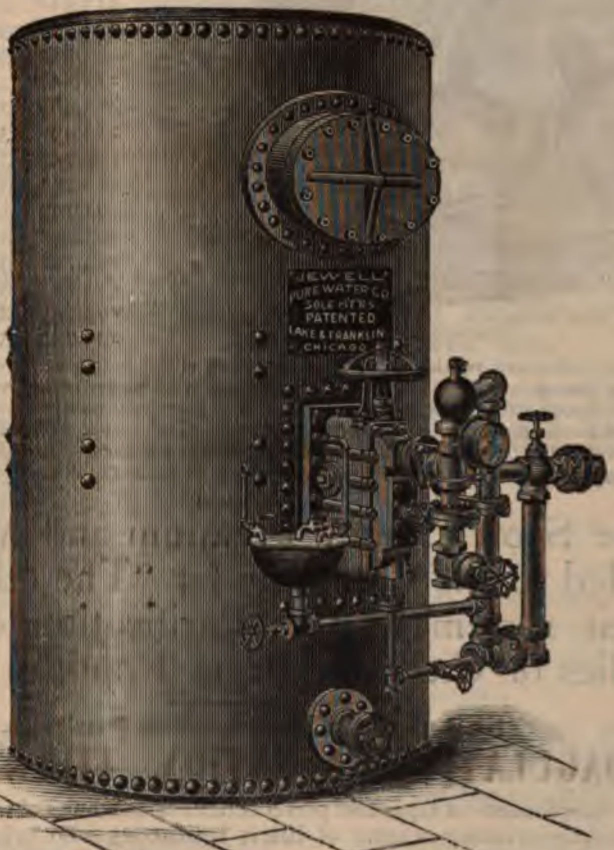

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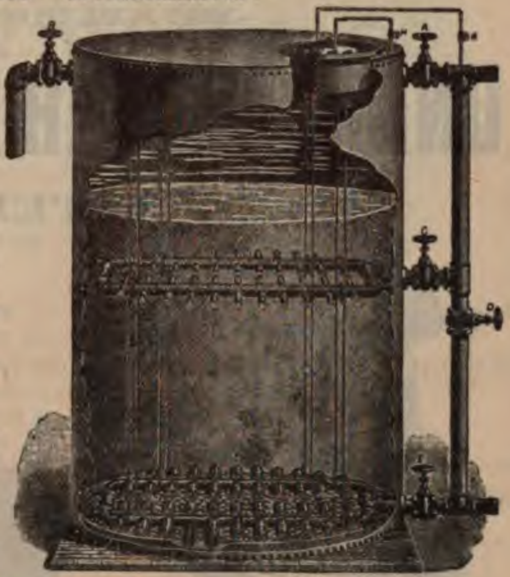

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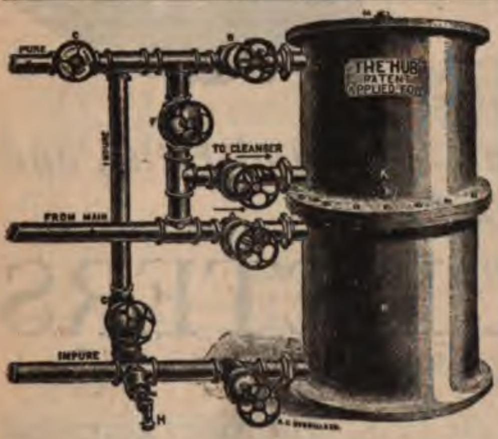

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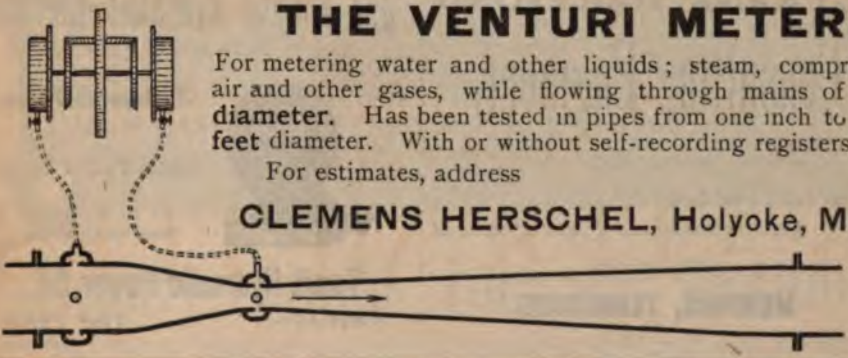

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Table of Contents.

Chapter I.--MAIN PIPES—
Materials—Cast-Iron—Cement-Lined Wr't. Iron—Salt-Glazed Clay—Thickness of Sheet Metal—Methods of Lining—List of Tools—Tool Box—Derrick—Calking Tools—Furnace—Transportation—Handling Pipe—Cost of Carting—Distributing Pipe.

Chapter II.—FIELD WORK—
Engineering or None—Pipe Plans—Special Pipe—Laying out a Line—Width and Depth of Trench—Time-Keeping Book—Disposition of Dirt—Tunneling—Sheet Piling.

Chapter III.—TRENCHING AND PIPE-LAYING—
Caving—Tunneling—Bell Holes—Stony Trenches—Feathers and Wedges—Blasting—Rocks and Water—Laying Cast-Iron Pipe—Derrick Gang—Handling the Derrick—Skids—Obstructions left in Pipes—Laying Pipe in Quicksand—Cutting Pipe.

Chapter IV.—PIPE-LAYING AND JOINT MAKING—
Laying Cement-Lined Pipe—"Mud" Bell and Spigot—Yarn—Lead—Jointers—Roll—Calking—Strength of Joints—Quantity of Lead.

Chapter V.—HYDRANTS, GATES, AND SPECIALS—

Chapters VI.—SERVICE-PIPES—
Definition—Materials—Lead vs. Wrought-Iron—Tapping Mains for Services—Different Joints—Compression Union—Cup.

Chapter VII.—SERVICE-PIPES AND METERS—
Wiped Joints and Cup-Joints—The Lawrence Air-Pump—Wire-drawn Solder—Weight of Lead Service-Pipe—Tapping Wrought-Iron Mains—Service-Boxes—Meters.

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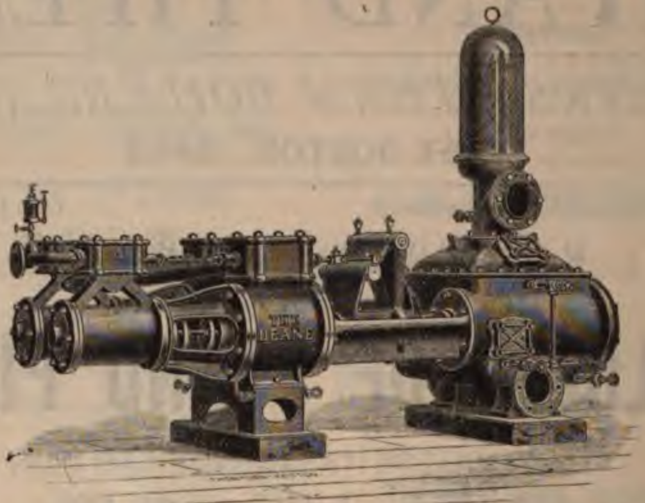

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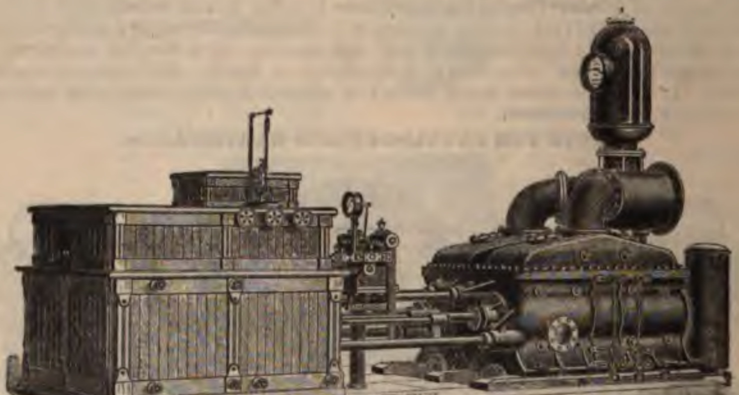

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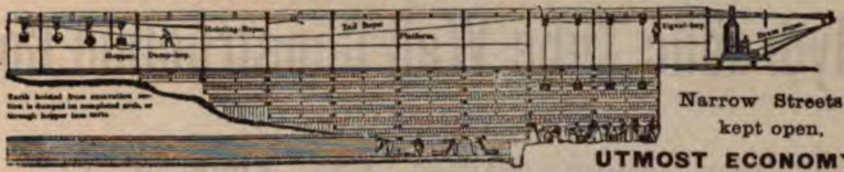

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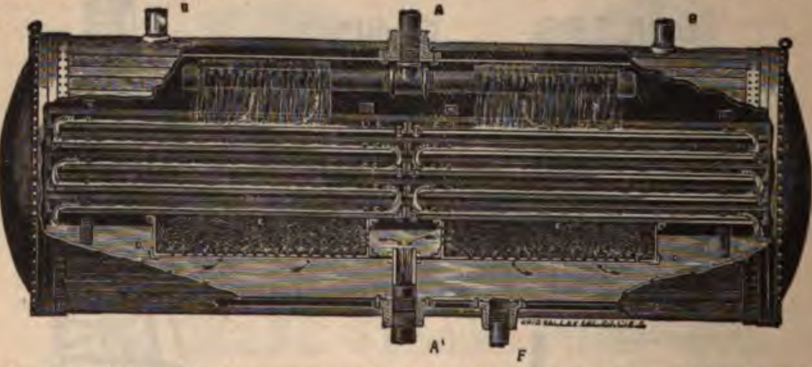

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TOLEDO, O., March 1, 1889

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Councilmen or local officers having little or no experience in such matters, cannot, as a rule, be expected to possess either the experience or technical knowledge necessarily requisite to successful results, and it therefore becomes simply a plain, common sense proposition, self-evident to every prudent business man, that the interests and safety of the city are best subserved and protected by calling into requisition the best obtainable engineering aid, and thus securing the benefits due to life-long study, added to as extensive, diversified and successful experience as may be obtainable, together with unquestioned professional and personal integrity—unbiassed by personal interest, directly or indirectly, in the manufacture or sale of pumping machinery, pipes, valves, hydrants, or any other material incident to the construction of water works, or other municipal improvements.

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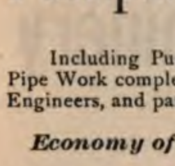

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Estimates furnished for any capacity up to 20,000,000 gallons daily. Duty guaranteed from 70,000 000 to 110,000,000 foot-pounds per 100 pounds of coal. Within the past six years, GASKILL ENGINES have been sold as follows:

Adrian, Mich	two	3,000,000	galls.
Albuquerque, N. M	one	3,000,000	"
Asbury Park, N. J	three	1,750,000	"
Ashland, Wis	two	3,000,000	"
Auburn, N. Y	two	12,500,000	"
Austin, Tex	one	3,000,000	"
Batavia, N. Y	one	1,500,000	"
Bay City, Mich	one	5,000,000	"
Beatrice, Neb	two	3,000,000	"
Beverly, Mass	two	4,000,000	"
Bloomsburg, Pa	one	2,500,000	"
Boston, Mass	two	16,000,000	"
Brockville, Ont	two	3,000,000	"
Buffalo, N. Y	three	55,000,000	"
Burlington, Iowa	one	3,000,000	"
Burlington, N. J	one	1,500,000	"
Cadillac, Mich	one	2,000,000	"
Carrollton, Mo	one	1,500,000	"
Chadron, Neb	two	1,500,000	"
Chatham, N. Y	one	1,000,000	"
Chester, Pa	two	8,000,000	"
Chicago, Ill	two	24,000,000	"
Circleville, O	two	3,000,000	"
Columbus, Ind	one	3,000,000	"
Columbus, Ohio	two	17,500,000	"
Covington, Ky	two	10,000,000	"
Corry, Pa	two	2,000,000	"
Dallas, Tex	one	8,000,000	"
Dayton, O	one	10,000,000	"
Denison, Tex	two	3,000,000	"
Des Moines, Iowa	one	5,000,000	"
Doylestown, Pa	one	1,500,000	"
East Orange, N. J	one	1,500,000	"
East Tawas, Mich	two	1,500,000	"
Easton, Md	one	500,000	"
Emporia, Kans	one	2,000,000	"
Erie, Pa	one	5,000,000	"
Evanston, Ill	one	5,000,000	"
Flint, Mich	two	3,000,000	"
Fond du Lac, Wis	two	6,000,000	"
Fort Wayne, Ind	one	6,000,000	"
Fort Worth, Texas	one	4,000,000	"
Fredericton, N. B	one	1,500,000	"
Fresno, Cal	one	1,000,000	"
Gainesville, Tex	one	1,500,000	"
Geneseo, N. Y	one	400,000	"
Highlands, Colo	one	700,000	"
Holmesburg, Pa	one	1,000 000	"
Hutchinson, Kan	one	1,500,000	"
Hyde Park, Ill	one	12,000,000	"
Indianapolis, Ind	two	10,000,000	"
Iowa City, Iowa	two	3,000,000	"
Jackson, Mich	one	4,000,000	"
Jamaica, L. I	two	2,000,000	"
Jeffersonville, Ind	two	3,000,000	"
Joliet, Ill	one	3,000,000	"
Kansas City, Mo	four	33,000,000	"
Kent, Ohio	two	2,000,000	"
Lake View, Ill	one	12,000,000	"
La Salle, Ills	one	2,000,000	"
Leavenworth, Kan	one	5,000,000	"
Le Mars, Ia	two	1,000,000	"
Lexington, Ky	two	3,000,000	"

Lima, Ohio	two	6,000,000	galls.
Lockport, N. Y	one	3,000,000	"
Ludington, Mich	one	3,000,000	"
Lynchburg, Va	one	3,000,000	"
Mamaroneck, N. Y	one	250,000	"
Manistee, Mich	two	3,000,000	"
McCormick, Harvester Co	two	3,000,000	"
Merchantsville, N. J	one	500,000	"
Michigan City	one	2,000,000	"
Mobile, Ala	two	12,000,000	"
Monmouth, Ill	one	1,000,000	"
Nashville, Tenn	one	12,500,000	"
Newark, Del	two	1,000,000	"
New Tacoma, W. T	one	1,000,000	"
Norfolk, Va	two	7,000,000	"
Oil City, Pa	one	1,500,000	"
Olathe, Kansas	one	1,000,000	"
Olean, N. Y	one	2,000,000	"
Omaha, Neb	two	20,000,000	"
Oshkosh, Wis	two	8,000,000	"
Paducah, Ky	two	4,000 000	"
Patchogue, L. I	two	1,400,000	"
Philadelphia, Pa	one	20,000,000	"
Philadelphia, Pa., (City Hall)	one	1,000,000	"
Philipsburg, Pa	one	1,000,000	"
Plymouth, Ind	two	1,500,000	"
Port Huron, Mich	one	5,000,000	"
Portland, Oregon	one	1,500 000	"
Pueblo, Col	one	1,500,006	"
Randolph, Mass	one	1,500,000	"
Richmond, Ind	one	4,000,000	"
Roanoke, Va	one	2,000,000	"
Rockford, Ill	one	3,000,000	"
Saginaw City, Mich	one	8,000,000	"
Salina, Kan	one	1,500,000	"
San Diego, Cal	one	2,000,000	"
San Diego, Cal	two	5 000,000	"
Santa Ana, Cal	one	1,000,000	"
Saratoga Springs, N. Y	two	13,000,000	"
Schenectady, N. Y	one	3,000,000	"
Sioux City, Iowa	two	5,000,000	"
Spokane Falls, W. T	two	7,800,000	"
Springfield, O	one	5,000,000	"
Springville, N. Y	one	1,000,000	"
Stevens Point, Wis	two	4,000,000	"
Streator, Ill	two	3,000,000	"
Suspension Bridge, N. Y	one	5,000,000	"
Tacoma, W. T	one	1,500,000	"
Tonawanda, N. Y	two	4,000,000	"
Town of Lake, Ill	one	12,000,000	"
Tiffin, Ohio	one	3,000,000	"
Union City, Pa	two	1,500,000	"
Urbana, O	one	2,000,000	"
Valparaiso, Ind	one	1,500,000	"
Vassar, Mich	one	1,500,000	"
Wabash, Ind	two	3 000,000	"
Washington, D. C	two	5,000,000	"
Washington, Ind	two	2,500,000	"
Wausau, Wis	two	6,000,000	"
West Bay City, Mich	two	3,000,000	"

183 engines. Total daily capacity, 614,000,000 galls.

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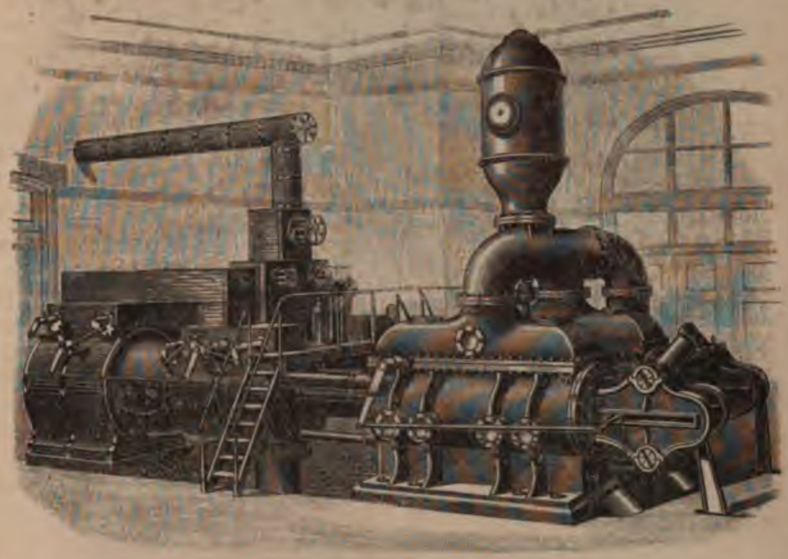

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